European Commission

Support study for the evaluation of the rules for operating aid under the EU aviation framework

Final Report

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Support study for the evaluation of the rules for operating aid under the EU aviation framework

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ABSTRACT (EN/FR/DE)

EN – This study aimed to assess whether the State aid rules on operating aid to regional airports set out in the 2014 Aviation Guidelines remain fit for purpose. First, the existing literature provides evidence that air traffic has a positive impact on regional development, especially in the service industries. The effects seem to be more pronounced for the most remote and economically depressed areas. Second, while the transitional period (2014-2024) for the phasing out of aid seems adequate for regional airports with more than 700,000 passengers per annum; many airports below this threshold will not be able to cover their operating costs by 2024, mostly the smallest ones. In fact, using survey data at the airport level, this study finds that all larger airports and a majority of airports with annual passengers between 200,001 and 700,000, should be able to fully cover their operating costs by 2024. On the contrary, only 38% of the airports up to 200,000 passengers are expected to cover their operating costs by 2024, although this group falls under the General Block Exemption Regulation since 2017 and is not exposed to the phasing out of operating aid. Third, current maximum aid intensity regimes seem appropriate for the majority of airports: in fact data shows that actual funding needs are expected to exceed maximum aid entitlement only for 23% of all airports between 200,001 and 700,000 passengers (these are also the airports that are not expected to reach equilibrium by 2024). Fourth, the analysis shows that passengers are an important predictor of profitability. Other determinants of profitability may provide additional insights, but most of them (*e.g.* the share of low-cost carriers) depend on airports' strategical choices. Therefore, they may be more apt to condition aid upon and be less suitable to help defining the need of aid. Finally, the evidence suggests that a finer passenger-based categorization might be a better predictor of airports' ability to cover operating costs.

FR – L'objet de la présente étude est de déterminer si les règles en matière d'aides d'État relatives aux aides au fonctionnement en faveur des aéroports régionaux énoncées dans les lignes directrices sur les aides d'État aux aéroports et aux compagnies aériennes de 2014 restent adaptées à leur objectif. Premièrement, la littérature existante prouve que le trafic aérien a un impact positif sur le développement régional, en particulier dans les industries de services. Les effets semblent être plus prononcés dans les régions les plus éloignées et économiquement défavorisées. Deuxièmement, si la période transitoire (2014-2024) pour la suppression progressive des aides semble adéquate pour les aéroports régionaux de plus de 700,000 passagers par an, de nombreux aéroports en dessous de ce seuil (surtout les plus petits) ne seront pas en mesure de couvrir leurs coûts de fonctionnement d'ici 2024. En fait, à l'aide de données récoltées grâce à une enquête auprès des aéroports, cette étude révèle que tous les grands aéroports et la majorité des aéroports dont le trafic varie entre 200,001 et 700,000 passagers annuels devraient être en mesure de couvrir entièrement leurs coûts de fonctionnement d'ici 2024. Au contraire, seuls 38% des aéroports, avec un trafic jusqu'à 200,000 passagers, devraient couvrir leurs coûts de fonctionnement d'ici 2024, bien que ce groupe relève du règlement général d'exemption par catégorie depuis 2017 et ne soit pas exposé à la suppression progressive des aides au fonctionnement. Troisièmement, les régimes actuels d'intensité maximale des aides semblent appropriés pour la majorité des aéroports : les données montrent que les besoins réels de financement ne devraient dépasser le plafond d'aide que pour 23% de tous les aéroports entre 200 001 et 700 000 passagers (ce sont également ces aéroports qui ne devraient pas atteindre un équilibre d'ici 2024). Quatrièmement, l'analyse montre que le volume de passagers est un

indicateur important de la rentabilité. D'autres facteurs peuvent fournir des indications supplémentaires sur la rentabilité, mais la plupart d'entre eux (par exemple la part des compagnies à bas coûts) dépendent des choix stratégiques des aéroports. Par conséquent, ces derniers peuvent être plus aptes à conditionner l'aide et moins aptes à contribuer à définir le besoin d'aide. Enfin, les données indiquent qu'une catégorisation plus fine fondée sur le nombre de passagers pourrait être un meilleur indicateur de la capacité des aéroports à couvrir les coûts d'exploitation.

DE – Das Ziel dieser Studie war die Untersuchung der Frage, ob die Vorschriften für staatliche Betriebsbeihilfen für Regionalflughäfen, wie sich in den Luftverkehrsleitlinien von 2014 vorgesehen sind, ihren Zweck weiterhin erfüllen. Zunächst ist darauf hinzuweisen, dass sich aus der vorhandenen Literatur schließen lässt, dass sich der Luftverkehr positiv auf die regionale Entwicklung, insbesondere auf die Dienstleistungsbranche, auswirkt. Die Auswirkungen scheinen für die abgelegensten und wirtschaftlich schwächsten Gebiete ausgeprägter zu sein. Zweitens scheint der Übergangszeitraum (2014-2024) für das schrittweise Auslaufen der Beihilfen für Regionalflughäfen mit mehr als 700.000 Fluggästen pro Jahr angemessen zu sein; viele, oftmals die kleinsten, Flughäfen unterhalb dieser Schwelle sind nicht in der Lage, ihre Betriebskosten bis zum Jahr 2024 zu decken. Die Umfrage auf Flughafenebene hat ergeben, dass alle größeren Flughäfen sowie die Mehrheit der Flughäfen mit Fluggästen zwischen 200.001 und 700.000 pro Jahr in der Lage sein sollten, ihre Betriebskosten bis 2024 vollständig zu decken. Dagegen wird davon ausgegangen, dass bis zum Jahr 2024 nur 38% der Flughäfen mit bis zu 200.000 Fluggästen ein kostendeckend agieren werden, obwohl diese Gruppe seit dem Jahr 2017 in den Anwendungsbereich der Allgemeinen Gruppenfreistellungsverordnung fällt und nicht vom Auslaufen der Betriebsbeihilfen betroffen ist. Drittens erscheint die derzeitige maximale Beihilfeintensität für die Mehrheit der Flughäfen angemessen zu sein: Die Daten belegen, dass der tatsächliche Finanzierungsbedarf den maximalen Beihilfeanspruch bei nur 23% Flughäfen mit einem Aufkommen von 200.001 bis 700.000 Fluggästen übersteigt (darunter fallen auch Flughäfen, die bis 2024 noch nicht kostendeckend sind). Viertens zeigt die Studie, dass Fluggäste ein wichtiger Indikator für die Rentabilität sind. Andere Bestimmungsfaktoren für die Rentabilität können zwar zusätzliche Erkenntnisse liefern, die meisten von ihnen (z.B. der Anteil der Low-Cost-Carrier) hängen aber von den strategischen Entscheidungen der Flughäfen ab. Diese Faktoren scheinen daher eher dafür geeignet zu sein, die Beihilfe an Bedingungen zu knüpfen, weniger geeignet dagegen, den Beihilfebedarf zu definieren. Schließlich deuten die Ergebnisse darauf hin, dass eine detailliertere, passagierbezogene Kategorisierung ein besserer Indikator für die Flughäfen sein könnte, die Betriebskosten zu decken.

EXECUTIVE SUMMARY (EN)

Context

In January 2019, the European Commission ("Commission") launched the evaluation of the rules, which were adopted as part of the 2012 State aid Modernisation package, as well as the Railways Guidelines and Commission communication on short-term export credit insurance.[1] Within this process, the Commission awarded to a consortium, led for this project by Lear and also including DIW Berlin and Sheppard Mullin ("Team") the retrospective evaluation study (the "Study") of the rules for operating aid to airports under the Guidelines on State aid to airports and airlines, adopted in the Communication from the Commission 2014/C 99/03 ("Aviation Guidelines"). Under the Aviation Guidelines, the Commission considers that airports should normally bear their operating costs. Nevertheless, regional airports (with annual passenger traffic of up to 3 million), in the light of their contribution to the connectivity of citizens and regional development, can receive operating aid only for a transitional period of ten years that will end on 3 April 2024. This measure is meant to enable small airports to adjust to the phasing out of operating aid, in consideration of the many changes that the industry has undergo since the liberalisation of air transport in 1997.

In the Aviation Guidelines, the Commission recognises that there is great variability in airports' profitability prospects depending on the airports' size (in terms of annual passenger traffic), due to the increasing economies of scale that characterise the industry. Larger size is associated with decreasing financial needs of airports. In particular, the Commission identifies five groups of airports based on the annual passenger traffic ("classes"): Class 1: 0-200,000; Class 2: 200,001-700,000; Class 3: 700,001-1 million; Class 4: 1,000,001-3,000,000; and Class 5: above 3 million. The rules under the Aviation Guidelines link the maximum intensity of operating aid permitted during the transitional period to the number of airport passengers and smaller airports could benefit from higher aid intensity than larger airports. Moreover, in 2017, the Commission has extended the scope of the General Block Exemption Regulation ("GBER") to operating aid granted to airports below 200,000 annual passenger traffic. Therefore, since 2017 operating aid to these airports is considered compatible with the EU internal market; as a consequence, these airports can receive operating aid to cover up to 100% of their operating losses before and beyond 2024.

Objectives

The objectives of the Study are to provide the Commission with an independent evidence-based assessment of the Aviation Guidelines in light of the three evaluation questions: (1) whether regional airports can contribute to regional development ("regional airports' contribution to regional development"); (2) whether the transitional period (2014-2024) provided under the Aviation Guidelines for the phasing out of operating aid is adequate to enable airports to achieve a self-sustainable operating performance ("adequacy of the transitional period"); (3) whether the categorisation of airports provided under the Aviation Guidelines to establish the need for

[1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on EU State Aid Modernisation (SAM), COM (2012) 209 final.

operating aid is suitable, and whether the aid intensity thresholds in the Aviation Guidelines are fit for purpose ("adequacy of the categorisation of airports").

Methodologies and measures employed

The Study relies on multiple methodologies. First, the Study relies on a review of the relevant literature to assess regional airports' contribution to regional development. Second, the assessment of the remaining two tasks of the Study relied on statistical, cluster and econometrics analysis using data at the airport level on past and expected financial performance and on annual passenger traffic.

The data has been collected for this purpose through a survey of airports located in different Member States. The final sample used in the analysis is based on the responses from 68 airports from 11 Member States. The data collected covers airports finances and characteristics over the period 2010-18, as well as predictions for the period 2019-2024 and includes, amongst others, information on public resources aimed at different purposes, the number, type and the revenue shares of airlines serving the airports, the business model of airports and the characterisation of the catchment area of airports. Regional statistics available from Eurostat on gross domestic product ("GDP"), population and employment at the level of NUTS 3 regions (the finest level of geographical aggregation) have been used as proxies for the development of the catchment area where airports are located. Airport-level annual data on passengers for all airports in the European Union ("EU") has also been collected from Eurostat.

In all the quantitative analyses, airport performance is measured by the Operating Funding Gap ("OFG") which is used in the Aviation Guidelines to quantify financial needs of airports eligible for aid. The OFG is calculated as "earnings before interests, taxes, depreciations and amortizations" ("EBITDA") minus all public resources that concern operating costs. Only a negative OFG over the transitional period is eligible for operating aid. Strictly speaking it would not usually make sense to talk about a positive OFG. However, since the objectives of the Study require the Team to assess the extent to which airports are expected to be profitable by the end of the transitional period, in this Study the term OFG is used as a measure of profitability, and as such it can be negative (signalling operating losses) or positive (signalling that operating revenues cover operating costs).

Assessment of the evaluation questions

(1) Regional airports' contribution to regional development

Three relevant strands of the literature have been identified to address the question of regional airports' contribution to regional development. First, the Team reviewed the literature on airports economics, discussing the potential determinants of the profitability of airports: air traffic size, ownership structure, proximity to other airports and other transport infrastructure, as well as economic incentives to attract airlines and the dependence on low-cost carriers ("LCCs"). The two latter have become of key importance since the liberalisation of air traffic within the EU in 1997. This first strand of literature also served as a backdrop to assess the two remaining evaluation questions. The existing evidence confirms the positive link between airport size and technical and economic efficiency, even though it does not suggest that there exists a minimum size for airports to break even. Regional airports often face limited demand, and there will inevitably be airports – even though run efficiently – not generating enough business to cover their operating costs. Small airports are often exposed to high seasonality of demand, which further reduces efficiency. There is mixed evidence on the benefits of an airport' private management by comparison to public management, both when looking at cost efficiency and at the level of airport charges. Moreover, the link between privatisation and efficiency found in some papers might not necessarily be causal, but rather linked to the fact that private investors invest in 'better' airports. The possible effects of competition between airports are two sided: it can increase efficiency, or it can lead to cannibalisation of air traffic demand when demand is limited relative to the size of air traffic local supply. Available evidence points to competition between airports leading to increased efficiency, but this could be due to the fact that competition is prevalent in the well-connected larger metropolitan areas, capable of sustaining several airports of sufficient scale. Furthermore, evidence on the effects of the LCCs share of traffic at an airport level is still scarce; when airports compete for airlines' services, incentive programs might not be sustainable in the long run and may lower profitability as LCCs carriers hold greater negotiation power in dealings with small airports. Moreover, LCCs appear to be increasingly turning from small airports towards the medium-large sized airports to attract business travellers. The regulatory environment could also be an important driver for airport efficiency especially when airports are not exposed to a competitive environment.

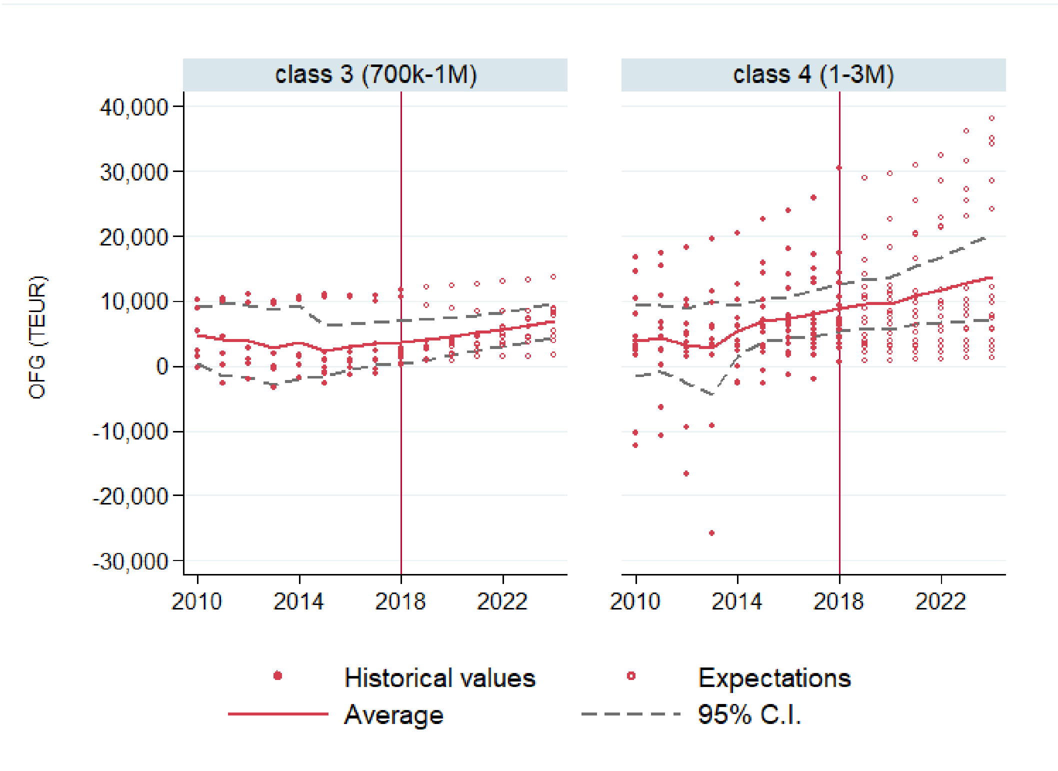
The second strand of the literature examines the relationship between air traffic and regional development. Even though in many papers a causal link between aviation and development is simply assumed, some notable exceptions provide empirical evidence that (increasing) air traffic indeed has a positive effect on economic growth. Overall, these studies confirm a positive impact in aggregate terms and specifically for service industries. The outcomes considered are employment, GDP and trade. Some studies have found effects to be particularly pronounced for the most remote areas that are truly inaccessible via alternative transport infrastructures, and that those regions are especially depressed in comparison to other geographical settings. One caveat to keep in mind is that reported effects can in most cases be considered as average among all airports as no studies specifically focus on regional airports only.

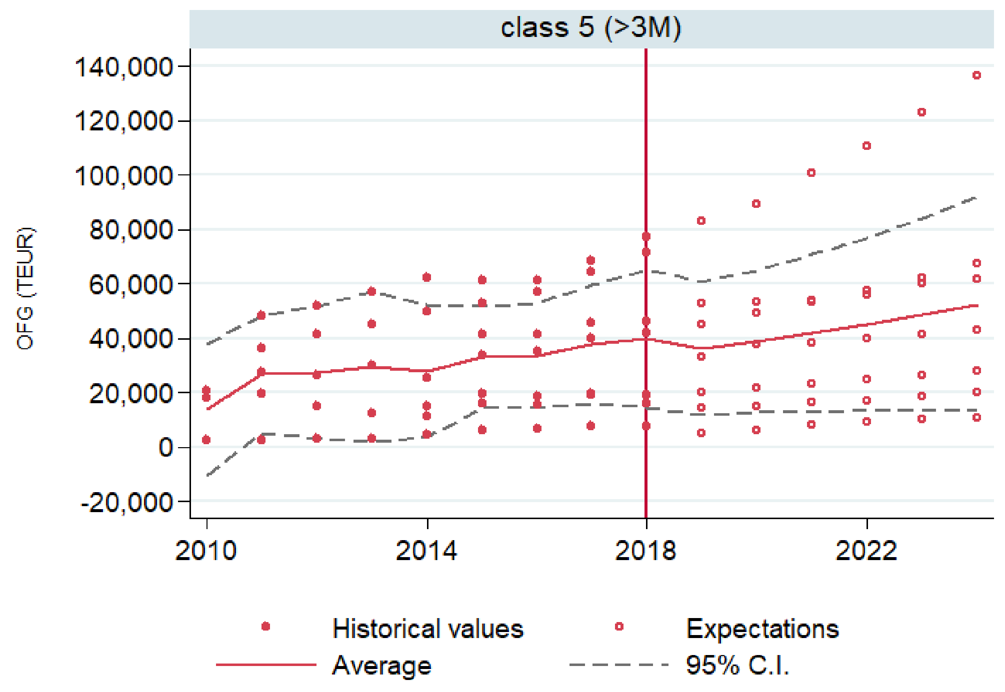
The Team has also reviewed the existing literature on the effects of public subsidies to regional airports. Evidence is still too scant to draw any reliable conclusions. Nevertheless, one can use the existing findings from the other two strands of the literature to reach some conclusions. Overall, it appears that smaller regional airports need some form of public long-lasting support to survive. The issue is therefore whether such support can be justified by the positive economic impact these airports bring to their respective regions. While positive externalities, such as agglomeration economies or connectivity benefits due to hub operation, tend to be associated with the large hubs rather than smaller regional airports, it can be surmised from the evidence on the effects of air traffic on regional development that there is a particular socio-economic benefit in connecting residents of remote and less connected areas to the larger regional or national grid for health, educational, or business purposes via air transport. Clearly, the issue of financial support for regional airports should be considered in light of the available evidence on the factors that impact airports' efficiency and/or profitability, discussed above, in order for aid to provide the right incentives for efficient management, avoid duplication of infrastructure and overcapacities. Last, the reviewed literature suggests that a sound costs and benefits analysis of the use of public resources should not disregard that increased access to one region may have negative economic spill over effects on other regions; that there are opportunity costs of funds used to support local airport infrastructure, and that these opportunity costs should include air traffic's negative externalities in terms of air pollution, noise and other environmental considerations, with respect to alternative (existing or potential) ways of connecting regions.

(2) Adequacy of the transitional period

Based on expectations, all airports above 700,000 passengers (classes 3, 4 and 5) should be able to fully cover their operating costs by 2024 (that is, to reach equilibrium: Figure 1 shows the evolution of OFG over time for airports that belong to these classes). Both when looking at sample data and at Eurostat data for all EU airports, classes 3, 4 (and 5) display a larger growth potential than smaller classes. Eurostat data also notably suggests that these airports tend to rapidly scale up above their class-specific boundaries. This overall suggests that the duration of the transitional period is likely to be adequate for airports above 700,000 passengers.

Figure 1 Evolution of the operating funding gap (OFG) for airports in classes 3 to 5



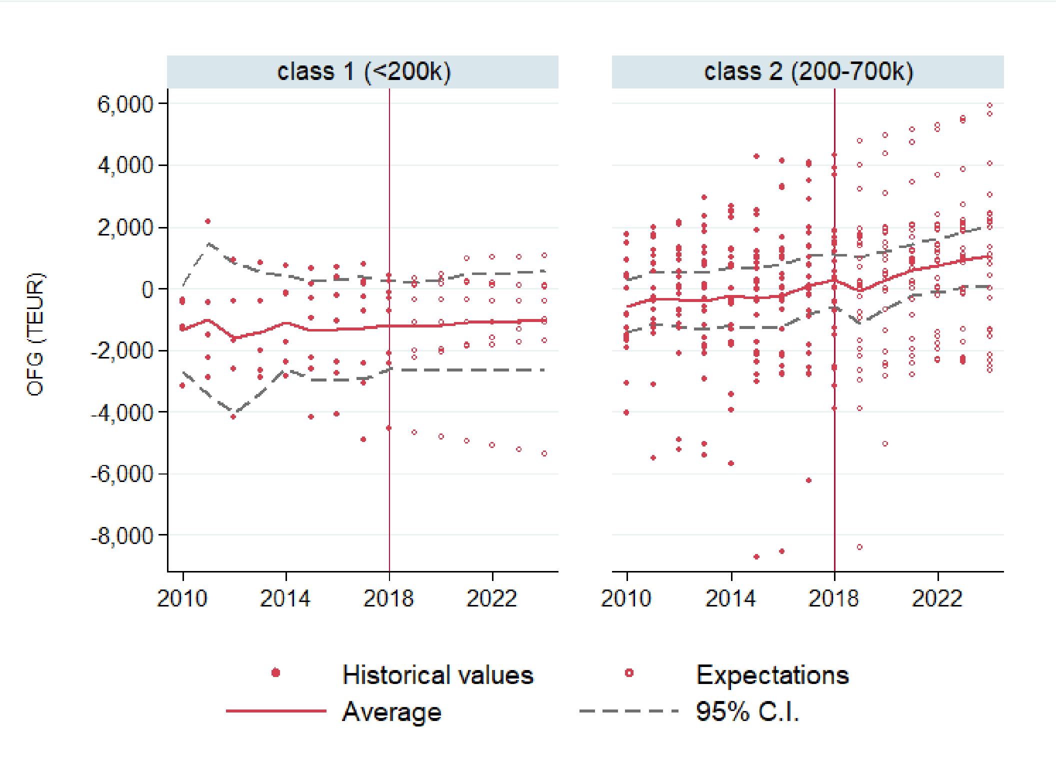


Source: Team based on sample data. The red circles represent all airport-year data. The red line represents the mean values; the dashed grey lines represent the 95% Confidence Interval for the mean (C.I.). Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Class boundaries are reported in parentheses above each graph. "k" is a shortcut for thousands; "M" is a shortcut for millions; "TEUR" is a shortcut for thousands of Euros.

Figure 2 shows the evolution of OFG over time for airports that belong to classes 1 and 2. The majority (69%) of airports belonging to class 2 (200,001-700,000 passengers) will be able to achieve equilibrium by 2024. In addition, those expected not to be in equilibrium by 2024 exhibit an improving trend especially relative to a drop experienced in 2019. These results suggest that the transitional period is adequate for the majority of airports in class 2 to reach equilibrium and that, on average, they are moving towards equilibrium. However, it is not possible to predict whether the few airports in this class that will not reach the target by 2024 will be able to achieve a positive OFG at some point, further in the future as the individual patterns are mixed.

The results for airports belonging to class 1 (up to 200,000 passengers) are different: first of all, only 37.5% will be able to achieve the equilibrium; secondly, they mostly show declining OFG trends (both those that are in equilibrium in 2024 and those that are not). The evidence provided in this Study also shows that none of the class 1 airports that have received operating aid is expected to reach financial equilibrium in 2024.

Figure 2 Evolution of the operating funding gap (OFG) for airports in classes 1 and 2



Source: Team based on sample data. Note: The red circles represent all airport-year data. The red line represents the mean values; the dashed grey lines represent the 95% Confidence Interval for the mean (C.I.). Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Class boundaries are reported in parentheses above each graph ("k" is a shortcut for thousands; "M" is a shortcut for millions; "TEUR" is a shortcut for thousands of Euros).

The performance of class 1 airports as a whole may be driven by a structural weakness, rather than the transitional period not being adequate. Such interpretation is consistent both with the literature and with a second complementary source of evidence. Eurostat data on passengers for all EU airports, not only shows that airports in class 1 experienced quite a flat traffic performance during the period 2010-2018; it also shows that on average, these airports hardly grow above 200,000 passengers over time. The same could be true for the few airports in class 2 that are expected not to reach equilibrium by 2024.

However, questioning the adequacy of the transitional period – as well as of aid intensity – for airports that belong to class 1 has lost most of its relevance since the Commission, as already mentioned, in 2017, has extended the scope of the GBER to operating aid granted to airports below 200,000 annual passenger traffic. Therefore, since 2017, as long as compatibility conditions hold, these airports can receive operating aid up to 100% of their operating losses, before and beyond 2024.

The Study also investigates the adequacy of operating aid intensity to overcome airports' temporary funding needs by 2024 for airports above the cut-off of 200,000 passengers per year, that are fully subject to the Aviation Guidelines rules, on which the Study focuses. For these airports, there is a maximum aid intensity, *i.e.* a percentage of the average initial OFG that can be covered by aid (average initial OFG is the annual average of the total OFG reported during the five years preceding the transitional period). Maximum aid intensity depends on the number of passengers: (i) airports above 200,000 and up to 700,000 passengers can receive up to 80% of their initial OFG; (ii) airports between 700,001 and 3 million passengers can receive up to 50% of their initial OFG; airports above 3 million passengers are not eligible for operating aid. The descriptive analysis shows that the exclusion of airports above 3 million passengers from access to operating aid is justified, as they always show a positive OFG, both before and during the transitional period. Among the remaining airports, all those entitled to 50% aid intensity, despite having a negative initial OFG before the start of the transitional period, show no financing needs thereafter (as such aid intensity did not constrain any of them). As to airports entitled to 80% aid intensity, the maximum entitlement of operating aid would be insufficient to fully cover needs only for a minority (23%) of all airports that fall in this group.

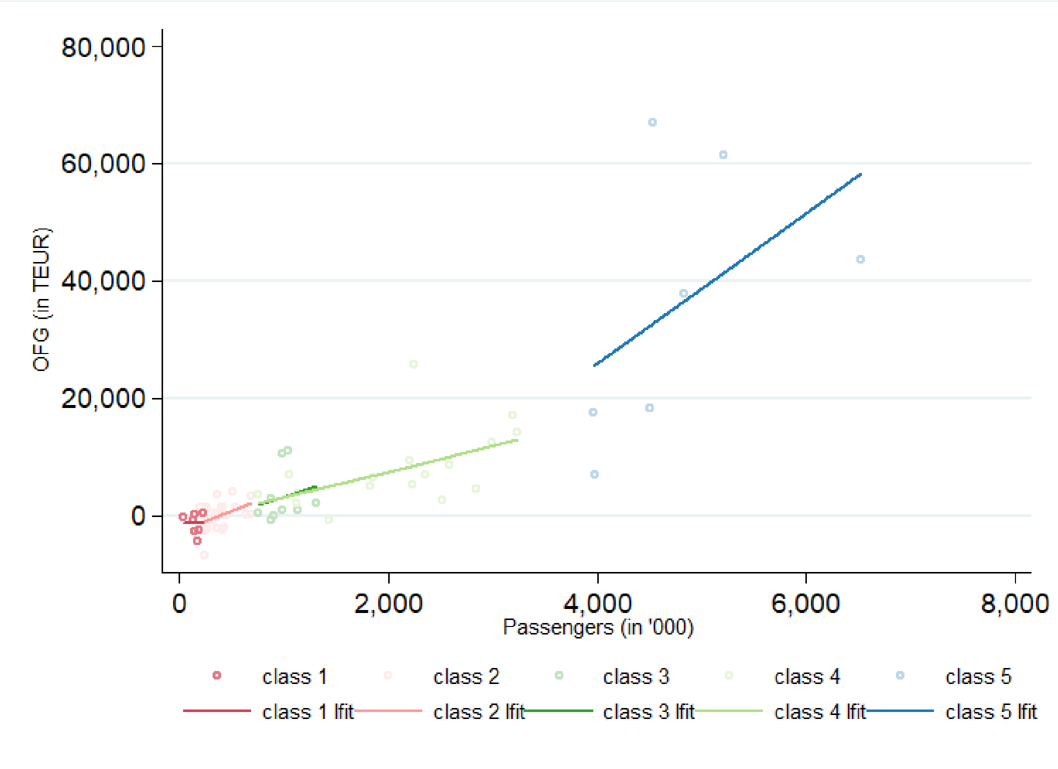
(3) Adequacy of the categorisation of airports

The evaluation of the adequacy of the categorisation of airports based on passenger traffic, implies several interrelated questions: whether the number of passengers is a relevant factor to establish the need of operating aid; whether it is also sufficient; and whether the thresholds currently implemented in the Aviation Guidelines to differentiate operating aid intensity are appropriate and, if not, which categorisation should be adopted.[2] To answer to these questions, we relied on historical data (2010-2018) rather than on expectations (2019-2024) as the latter are more speculative.

The analysis undertaken in the Study shows that passengers are certainly important for an airport's profitability, confirming the results of the existing literature. Moreover, the positive correlation between airport's traffic and its profitability, as measured by OFG, is stronger the larger the size of the airport in terms of passengers (see Figure 3). This correlation persists even after controlling for other factors that appear to be important determinants of profitability.

[2] As already explained, airports can be grouped into different operating aid intensity regimes, depending on annual passengers: (i) aid intensity of 100% for airports up to 200,000 passengers (this cut-off has become relevant only since 2017, as a consequence of the GBER extension); (ii) aid intensity of 80% for airports above 200,000 and up to 700,000 passengers; (iii) 50% aid intensity for airports above 700,000 and up to 3 million passengers. Airports with more than 3 million passengers cannot access operating aid.

Figure 3 Relationship between the operating funding gap (OFG) and passengers. Average values over the years 2015-2018



Source: Team based on sample data. Note: Airport-level data. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Different colours identify different classes. "lfit" is a shortcut for "linear fit", a straight line representing the best linear prediction of the variable reported on the vertical axis (OFG) by the variable reported on the horizontal axis (passengers). "TEUR" is a shortcut for thousands of Euros.

Addressing the first question, the results of our analyses clearly show the number of passengers positively correlates with the average OFG over the sample period: more passengers are related to higher profitability. However, moving to the second question, there seems to be quite some heterogeneity within and across classes.

The cluster and the econometric analyses further clearly show that other factors may have a relevant impact on the definition of the need for aid. The most important are the share of passengers coming from LCCs, the ratio of incentives paid to airlines per passenger and the attractiveness of the areas where airports are located. However, including them to establish the need for operating aid is not straightforward. In particular, the LCCs share of passengers is shown to decrease profitability of passengers for the smallest airports. This evidence is driven by small airports with a very high share of passengers coming from LCCs. Second, incentives to airlines also seem to decrease profitability. Third, local conditions also play a role: airports in richer and better-connected areas are more profitable. The existing literature adds to this by showing that other market characteristics, that we could not control for in our Study, such as market power and congestion, regulation of prices, negotiating power with respect to air carriers; and the type of traffic that the airport attracts are relevant characteristics impacting profitability.

Focusing on differences within classes, since most of class 1 airports never manage to be profitable, the number of passengers seems to be a sufficient indicator of profitability up to

200,000 passengers. Looking at differences within class 2, other factors than the total number of passengers (especially the share of LCCs passenger), help to explain why some airports in class 2 manage to become profitable while others do not. Most of the airports in class 3 and class 4 (both in the current 50% aid intensity regime) were already profitable over the period 2015-2018 (they are all expected to be so by 2024 but they were not all so in the past); thus, given this evidence, passengers may be sufficient to forecast their funding needs. However, significant differences are also found within these two classes over the period 2015-2018. These 'within' differences are related to the share of LCCs passengers and the attractiveness of the areas where airports are located. Finally, very large airports (above 3 million passengers per year) are always profitable. Hence, the number of passengers seems to be enough to identify their (lack of) need for operating aid.

These insights allow us to shed light on whether the number of passengers is sufficient to establish the need of operating aid. Apart from the smallest airports with annual traffic below 200,000 passengers per year (and for those above 3 million passengers per year that are always profitable), there are additional factors that may provide useful insights on the self-sustainability of airports and help forecasting the airports' financial needs. However, apart from the attractiveness and connectedness of the region served by the airport, all other relevant factors are at least in part affected by the strategical choices of airports' themselves. As such, they may be used to condition aid and are less suitable to define a different categorisation of aid intensity.

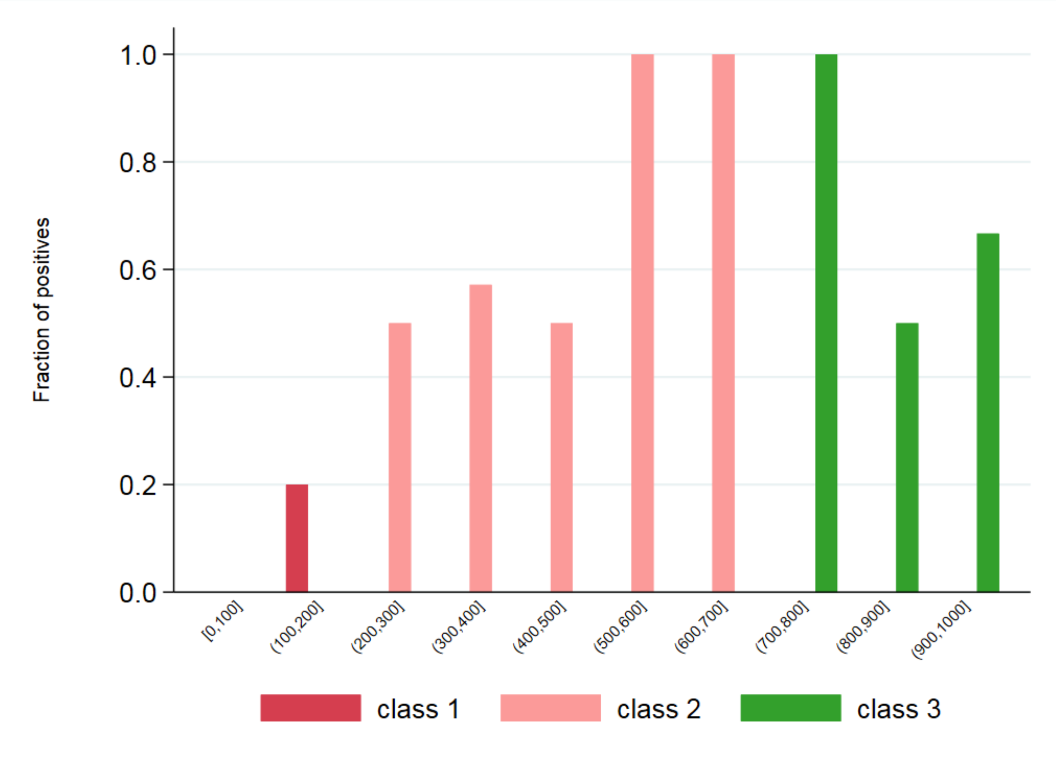
Moving to the final question on the appropriateness of the original categorisation of airports adopted in 2014 for the purposes of defining aid intensities, the Study shows that the finer five-class categorisation (Class 1: 0-200,000; Class 2: 200,001-700,000; Class 3: 700,001-1 million; Class 4: 1,000,001-3 million; and Class 5: above 3 millions) might have been a better predictor of an airport's ability to cover its operating costs, and there may be room for further improvement.

First, our analysis indicates that there is a clear cut-off at 200,000 passengers, below which it is very unlikely for an airport to be financially viable. The marked diversity of airports below 200,000 passengers with respect to all other airports is supported by descriptive analysis, by cluster analysis and by regression results.

This could be seen through a simple graph of how OFG varies at different levels of annual passengers, where differences between class 1 and class 2 are quite evident (see Figure 4; only the results up to 1 million passengers are reported as, above that level, average OFG lies almost always above zero). Airports with passenger traffic between 200,001 and 300,000, look already quite different from those below this range; in fact, a substantial share of the former (almost 50%) has a positive OFG. Thus, class 1 appears to indeed identify a group of airports that are different from other airports. This cut-off, however, is already subsumed in the current operating aid intensity regime since 2017, as a consequence of the GBER extension.

Second, whilst from 300,001 passengers onwards, the median of the OFG distribution always lies above zero and differences within class 2 and class 3 are less pronounced; yet airports with a traffic between 200,001 and 500,000 passengers are quite similar in terms of the fraction of breaking even airports; at the same time, they seem different from airports with a traffic between 500,001 and 700,000, although all these airports are grouped in class 2. From Figure 4, it would seem that also airports with a traffic between 800,001 and 900,000 (or 900,001 and 1 million) passengers are different from other airports in their class. However, all these airports are expected to have a positive average OFG during the period 2019-2024 (the fraction of breaking even is 100% by 2024). Larger categories display, instead, a very similar fraction of airports with a positive OFG.

Figure 4 Fraction of airports with positive OFG (based on average values over the years 2015-2018), by different passenger thresholds ('000)



Source: Team based on sample data. Note: Airports are grouped into 5 classes based on average number of passengers in the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Different colours identify different classes. The figure is restricted to airports with an average number of passengers in the years 2015-2018 not exceeding 1 million passengers.

RESUME (FR)

Contexte

En janvier 2019, la Commission européenne («la Commission») a lancé une évaluation des règles adoptées dans le cadre de la Modernisation de 2012 en matières d'aides d'État,[3] ainsi que les lignes directrices sur les aides d'État aux entreprises ferroviaires et la Communication de la Commission concernant l'assurance-crédit à l'exportation à court terme. Dans le cadre de ce processus, la Commission a confié à un consortium, dirigé pour ce projet par Lear et comprenant également DIW Berlin et Sheppard Mullin (l'«Équipe»), l'étude d'évaluation rétrospective (l'«Étude») des règles relatives aux aides au fonctionnement des aéroports et aux compagnies aériennes, adoptées dans la communication 2014/C 99/03 de la Commission («lignes directrices sur le transport aérien»). En vertu des lignes directrices sur le transport aérien, la Commission considère que les aéroports devraient normalement supporter leurs coûts d'exploitation. Néanmoins, les aéroports régionaux (dont le trafic annuel ne dépasse pas 3 millions de passagers), compte tenu de leur contribution à la connectivité des citoyens et au développement régional, ne peuvent bénéficier d'aides au fonctionnement que pendant une période transitoire de dix ans qui prendra fin le 3 avril 2024. Cette mesure vise à permettre aux petits aéroports de s'adapter à la suppression progressive des aides au fonctionnement, compte tenu des nombreux changements que le secteur a connus depuis la libéralisation du transport aérien en 1997.

Dans les lignes directrices sur le transport aérien, la Commission reconnaît que les perspectives de rentabilité des aéroports varient considérablement en fonction de leur taille (en termes de trafic aérien annuel), en raison des économies d'échelle croissantes qui caractérisent ce secteur. On considère qu'une plus grande taille est associée à une diminution des besoins financiers des aéroports. En particulier, la Commission identifie cinq groupes d'aéroports en fonction de leur trafic de passagers annuel («classes»), classe 1: 0-200 000; classe 2: 200 001-700 000; classe 3: 700 001-1 million; classe 4: 1 000 001-3 000 000; et classe 5: plus de 3 millions. Les règles des lignes directrices sur le transport aérien lient en effet l'intensité maximale de l'aide autorisée pendant la période transitoire au nombre de passagers des aéroports et les petits aéroports peuvent bénéficier d'une intensité d'aide plus élevée que les grands aéroports. En outre, en 2017, la Commission a étendu le champ d'application du règlement général d'exemption par catégorie («RGEC») aux aides au fonctionnement accordées aux aéroports dont le trafic annuel est inférieur à 200,000 passagers. Dès lors, depuis 2017, les aides au fonctionnement accordées à ces aéroports sont considérées comme compatibles avec le marché intérieur de l'UE ; et donc par conséquent, ces aéroports peuvent recevoir des aides au fonctionnement pour couvrir jusqu'à 100 % de leurs pertes d'exploitation avant et après 2024.

Les objectifs

Les objectifs de l'Étude sont de fournir à la Commission une évaluation indépendante des lignes directrices sur le transport aérien fondée sur des données probantes à la lumière des trois questions d'évaluation: (1) les aéroports régionaux peuvent-ils contribuer au développement régional («contribution des aéroports régionaux au développement régional»)?; (2) la période transitoire (2014-2024) prévue par les lignes directrices sur le transport aérien pour la

[3] Communication de la Commission au Parlement européen, au Conseil, au Conseil économique et social et au Comité des régions sur la modernisation des aides d'État, COM(2012) 209 final.

suppression progressive des aides au fonctionnement est-elle suffisante pour que les aéroports atteignent un fonctionnement autonome («caractère adéquat de la période transitoire»)?; (3) la classification des aéroports établie dans les lignes directrices pour déterminer les besoins en aides au fonctionnement est-elle adéquate, et les seuils d'intensité des aides indiquées dans les lignes directrices correspondent-elles aux objectifs? («adéquation de la catégorisation des aéroports»).

Méthodologies et mesures employées

L'Étude repose sur de multiples méthodologies. Premièrement, elle s'appuie sur un examen de la littérature pertinente pour évaluer la contribution des aéroports régionaux au développement régional. Deuxièmement, l'évaluation des deux autres tâches de l'Étude d'évaluation repose sur une analyse statistique, groupée et économétrique, utilisant des données au niveau des aéroports sur le rendement financier passé et prévu ainsi que sur le trafic annuel de passagers.

Les données ont été collectées à cette fin par le biais d'une enquête auprès des aéroports situés dans différents États membres. L'échantillon final utilisé dans l'analyse est basé sur les réponses de 68 aéroports de 11 États membres. Les données recueillies portent sur les finances et les caractéristiques des aéroports pour la période 2010-2018, ainsi que sur les prévisions pour la période 2019-2024 et comprennent, entre autres, des informations sur les ressources publiques destinées à des fins différentes, le nombre, le type et la part des recettes des compagnies aériennes desservant les aéroports, le modèle économique des aéroports et la détermination de la zone d'attraction des aéroports. Les statistiques régionales disponibles auprès d'Eurostat sur le PIB, la population et l'emploi au niveau des régions NUTS 3 (le niveau le plus fin d'agrégation géographique) ont été utilisées comme approximations pour le développement de la zone desservie où sont situés les aéroports. Des données annuelles au niveau des aéroports sur les passagers pour tous les aéroports de l'Union européenne (« UE ») ont également été collectées auprès d'Eurostat.

Dans toutes les analyses quantitatives, la performance des aéroports est mesurée par l'écart de financement de fonctionnement («EFF») qui est utilisé dans les lignes directrices sur le transport aérien pour quantifier les besoins financiers des aéroports éligibles aux aides. L'EFF est calculé comme le «bénéfice avant intérêts, impôts, amortissements et dépréciations» («BAIIA» ou «EBITDA»)) moins toutes les ressources publiques qui concernent les frais d'exploitation. Seul un déficit de financement du fonctionnement négatif au cours de la période transitoire est éligible à une aide au fonctionnement. À proprement parler, il ne serait généralement pas logique de parler d'un « écart » positif en matière de financement de fonctionnement. Toutefois, puisque les objectifs de l'étude exigent une évaluation de la mesure dans laquelle les aéroports devraient être rentables d'ici la fin de la période de transition, dans la présente étude, l'EFF est utilisé comme mesure de la rentabilité et, à ce titre, il peut être négatif (indiquant les pertes d'exploitation) ou positif (indiquant que les recettes d'exploitation couvrent les coûts d'exploitation).

Évaluation des questions d'évaluation

(1) Contribution des aéroports régionaux au développement régional

Trois volets pertinents de la littérature ont été identifiés pour aborder la question de la contribution des aéroports régionaux au développement régional. Premièrement, la littérature sur l'économie aéroportuaire a été passée en revue, en examinant les facteurs potentiels déterminant la rentabilité des aéroports : volume du trafic aérien, structure de propriété, proximité d'autres aéroports et autres infrastructures de transport, ainsi que les incitations économiques pour attirer les compagnies aériennes et la dépendance vis-à-vis des Compagnies à bas prix («CBP»); ces deux derniers ont acquis une importance cruciale depuis la libéralisation du trafic aérien dans l'UE en 1997. Ce premier volet de la littérature a également servi de toile de fond pour évaluer les deux autres questions d'évaluation. Les données existantes confirment le lien positif entre la taille des aéroports et l'efficacité technique et économique, même si elles ne suggèrent pas qu'il existe une taille minimale pour que les aéroports atteignent le seuil de rentabilité. Les aéroports régionaux font souvent face à une demande limitée et il y aura inévitablement des aéroports – quand bien même ceux-ci sont gérés efficacement - qui ne généreront pas suffisamment d'activités pour couvrir leurs coûts d'exploitation. Les petits aéroports sont souvent exposés à une forte saisonnalité de la demande, ce qui réduit encore davantage leur efficacité. Les avantages de la gestion privée d'un aéroport par rapport à la gestion publique ne sont pas tous aussi évidents, qu'il s'agisse du rapport coût-efficacité ou du niveau des redevances aéroportuaires. En outre, le lien entre la privatisation et l'efficacité constaté dans certains documents n'est pas nécessairement causal, pour autant que les investisseurs privés investissent dans des aéroports « meilleurs ». Les effets possibles de la concurrence entre aéroports sont doubles : elle peut accroître l'efficacité ou conduire à une cannibalisation de la demande de trafic aérien lorsque la demande est limitée par rapport à la taille de l'offre locale de trafic aérien. Les données disponibles indiquent que la concurrence entre les aéroports conduit à une efficacité accrue, mais cela pourrait être dû au fait que la concurrence prévaut dans les grandes zones métropolitaines bien desservies, capables de soutenir plusieurs aéroports de taille suffisante. En outre, les données sur les effets de la part du trafic des CBP au niveau des aéroports sont encore rares ; lorsque les aéroports se font concurrence pour les services des compagnies aériennes, les programmes d'incitation pourraient ne pas être viables à long terme et pourraient réduire la rentabilité car les CBP détiennent un pouvoir de négociation accru dans leurs transactions avec les petits aéroports. De plus, les CBP semblent se tourner de plus en plus des petits aéroports vers les aéroports de taille moyenne et de grande taille pour attirer les voyageurs d'affaires. L'environnement réglementaire pourrait également être un facteur important d'efficacité aéroportuaire, en particulier lorsque les aéroports ne sont pas exposés à un environnement concurrentiel.

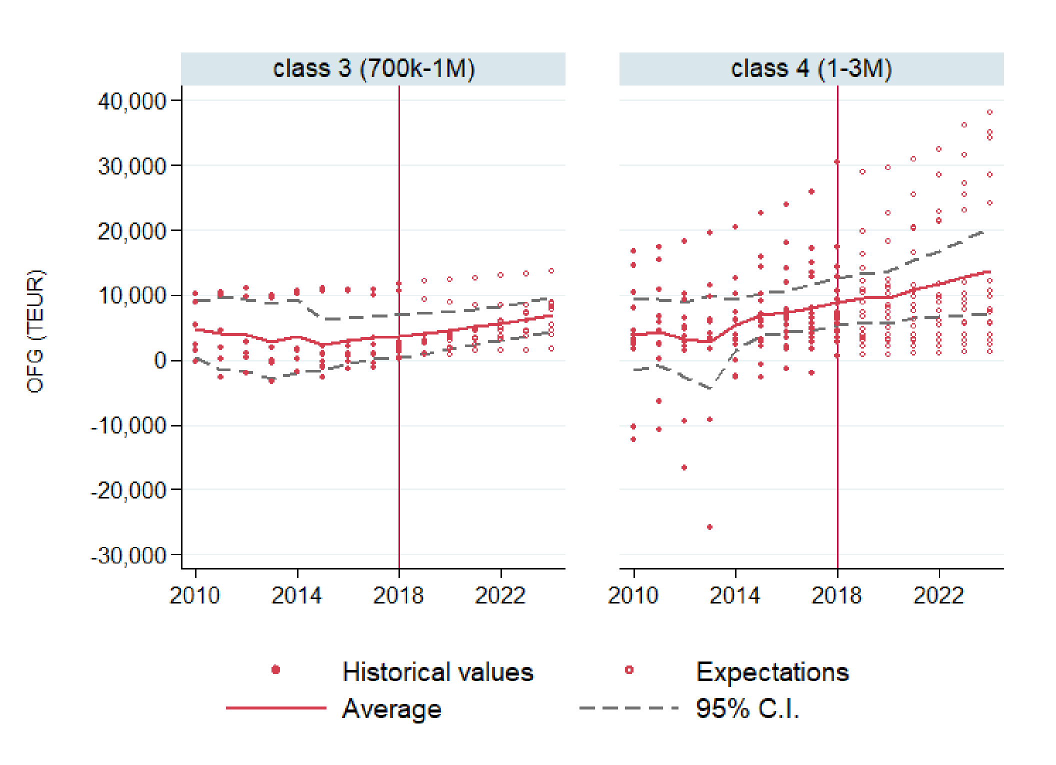
Le deuxième volet de la littérature porte sur la relation entre le trafic aérien et le développement régional. Même si, dans de nombreux documents, un lien de causalité entre l'aviation et le développement est simplement supposé, certaines exceptions notables fournissent des preuves empiriques que le trafic aérien (croissant) a effectivement un effet positif sur la croissance économique. Dans l'ensemble, ces études confirment un impact positif en termes agrégés et spécifiquement pour les industries de services. Les résultats considérés sont l'emploi, le PIB et le commerce. Certaines études ont montré que les effets étaient particulièrement prononcés dans les zones les plus reculées qui sont réellement inaccessibles par le biais d'infrastructures de transport alternatives, et que ces régions sont particulièrement défavorisées par rapport à d'autres contextes géographiques. Une mise en garde s'impose : dans la plupart des cas, les effets signalés peuvent être considérés comme moyens dans tous les aéroports, car aucune étude ne porte spécifiquement sur les aéroports régionaux seulement.

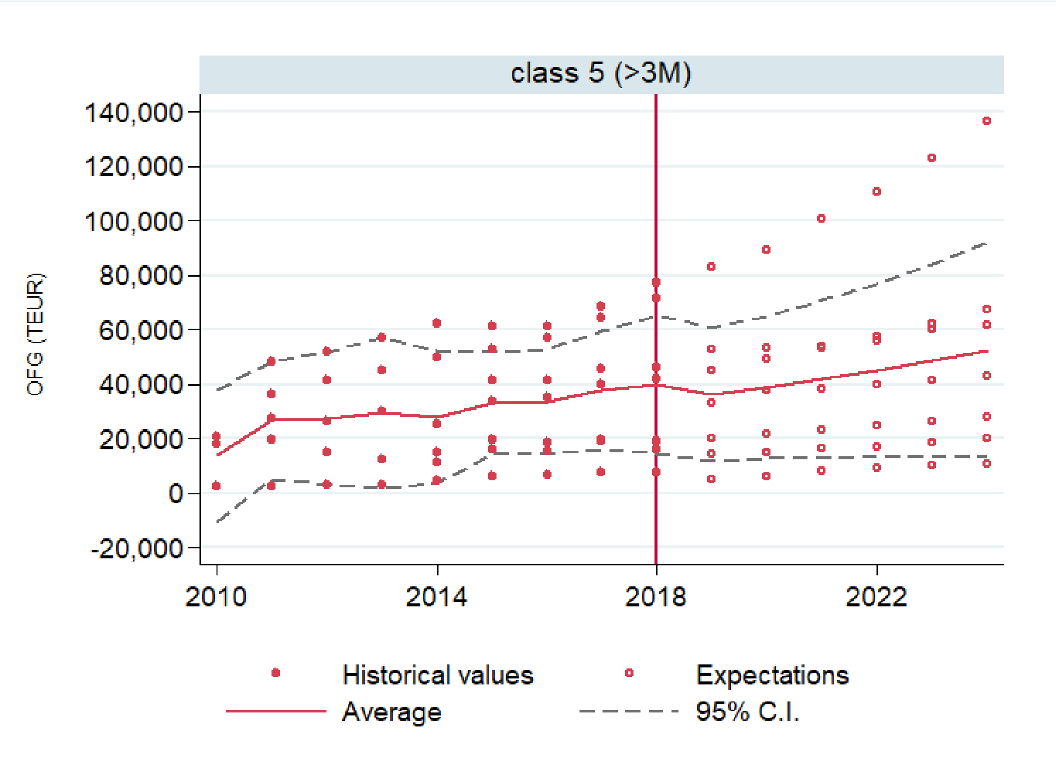
L'étude a également examiné la littérature existante sur les effets des aides d'État aux aéroports régionaux. Les preuves sont encore trop rares pour que l'on puisse en tirer des conclusions fiables. Néanmoins, les résultats existants des deux autres volets de la littérature peuvent être utilisés pour arriver à certaines conclusions. Dans l'ensemble, il semble que les petits aéroports régionaux ont besoin d'une certaine forme de soutien public durable pour survivre. La question est donc de savoir si un tel soutien peut être justifié par l'impact économique positif que ces aéroports apportent à leurs régions respectives. Alors que les externalités positives, telles que les économies d'agglomération ou les avantages de connectivité dus à l'exploitation de la plaque tournante, tendent à être associées aux grands hubs plutôt qu'aux petits aéroports régionaux, on peut supposer, d'après les données relatives aux effets du trafic aérien sur le développement régional, qu'il existe un avantage socio-économique particulier à relier les résidents des zones éloignées et moins connectées au grand réseau régional ou national à des fins sanitaires, éducatives ou commerciales par les transports aériens. De toute évidence, la question du soutien financier aux aéroports régionaux devrait être examinée à la lumière des éléments disponibles concernant les facteurs qui influent sur l'efficacité et/ou la rentabilité des aéroports, examinés plus haut, afin que l'aide fournisse les incitations appropriées à une gestion efficace, évite la duplication des infrastructures et les surcapacités. Enfin, la documentation examinée suggère qu'une analyse judicieuse des coûts et des avantages de l'utilisation des ressources publiques ne doit pas faire abstraction du fait qu'un accès accru à une région peut avoir des retombées économiques négatives sur d'autres régions ; que les fonds utilisés pour soutenir les infrastructures aéroportuaires locales comportent des coûts de renonciation et que ces coûts devraient comprendre les effets externes négatifs du trafic aérien en matière de pollution atmosphérique, de bruit et autres considérations environnementales, relativement aux autres moyens (existants ou potentiels) de relier des régions.

(2) Adéquation de la période de transition

Selon les prévisions, tous les aéroports de plus de 700 000 passagers (classes 3, 4 et 5) devraient être en mesure de couvrir entièrement leurs coûts d'exploitation d'ici 2024 (c'est-à-dire d'atteindre un équilibre) : la Figure 1 montre l'évolution de l'EFF au fil du temps pour les aéroports qui appartiennent à ces classes). Les classes 3, 4 (et 5) présentent un potentiel de croissance plus important que les classes plus petites, tant pour les données de l'échantillon que pour les données d'Eurostat pour tous les aéroports de l'UE. Les données d'Eurostat suggèrent également que ces aéroports ont tendance à dépasser rapidement les limites de leurs classes spécifiques. Dans l'ensemble, cela suggère que la durée de la période de transition sera probablement suffisante pour les aéroports de plus de 700 000 passagers.

Figure 1 Évolution de l'écart de financement de fonctionnement (OFG ou EFF) des aéroports des classes 3 à 5



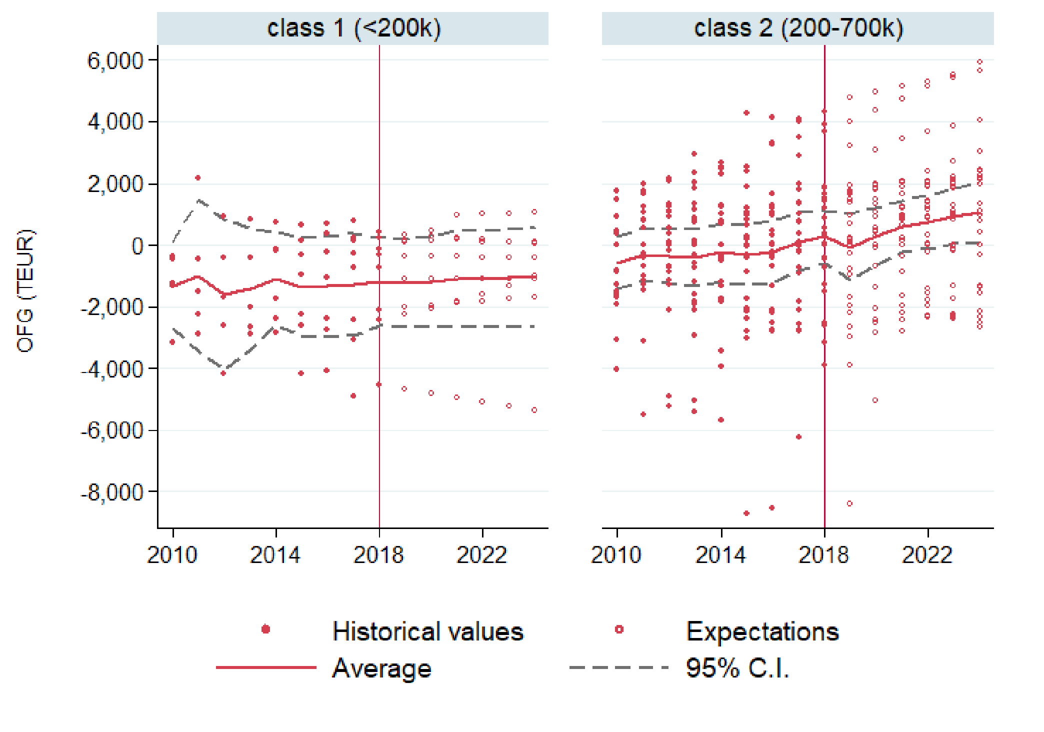


Source : données d'échantillon de l'Étude. Note : Les cercles rouges représentent toutes les données de l'année aéroportuaire. La ligne rouge représente les valeurs moyennes ; les lignes grises en pointillés représentent l'intervalle de confiance à 95% pour la moyenne (C.I.). Les aéroports sont regroupés en 5 classes selon le nombre de passagers (en milliers : classe 1 : 0-200 ; classe 2 : 200-700 ; classe 3 : 700-1,000 ; classe 4 : 1,000-3,000 ; classe 5 : >3,000). Les limites des classes sont indiquées entre parenthèses au-dessus de chaque graphique. « k » est un raccourci pour des milliers ; «M» est un raccourci pour des millions ; «TEUR» est un raccourci pour «milliers d'euros».

La Figure 2 montre l'évolution de l'EFF au fil du temps pour les aéroports qui appartiennent aux classes 1 et 2. La majorité (69%) des aéroports appartenant à la classe 2 (200,001-700 000 passagers) pourront atteindre l'équilibre en 2024. En outre, ceux qui ne devraient pas être en mesure d'atteindre l'équilibre d'ici 2024 affichent toutefois des tendances à la hausse, surtout par rapport à la baisse enregistrée en 2019. Ces résultats suggèrent que la période de transition est suffisante pour qu'une majorité des aéroports de la classe 2 atteignent l'équilibre et que, en moyenne, ceux qui n'atteindront pas l'objectif se dirigeront vers l'équilibre. Toutefois, il est impossible de prédire si les quelques aéroports de cette classe qui n'atteindront pas l'objectif d'ici 2024 seront en mesure d'atteindre un EFF positif à un moment donné, plus tard dans l'avenir, car les tendances individuelles sont mixtes.

Les résultats pour les aéroports appartenant à la classe 1 (jusqu'à 200 000 passagers) sont différents: d'une part, seuls 37,5% pourront atteindre l'équilibre ; d'autre part, ils montrent surtout des tendances à la baisse des EFF (tant ceux qui seront en équilibre en 2024 que ceux qui ne le seront pas). Les éléments de preuve fournis dans la présente étude montrent également qu'aucun des aéroports de classe 1 ayant reçu une aide au fonctionnement ne devrait atteindre l'équilibre financier en 2024.

Figure 2 Évolution de l'écart de financement du fonctionnement (OFG ou EFF) des aéroports des classes 1 et 2



Source : données d'échantillon de l'Étude. Note : Les cercles rouges représentent toutes les données de l'année aéroportuaire. La ligne rouge représente les valeurs moyennes ; les lignes grises en pointillés représentent l'intervalle de confiance à 95% pour la moyenne. Les délimitations de classe sont indiquées entre parenthèses au-dessus de chaque graphique ("k" indique des milliers ; "M" signifie des millions). Les aéroports sont regroupés en 5 classes selon le nombre de passagers (en milliers : classe 1 : 0- 200 ; classe 2 : 200-700 ; classe 3 : 700-1,000 ; classe 4 : 1,000-3,000 ; classe 5 : >3,000). Les limites des classes sont indiquées entre parenthèses au-dessus de chaque graphique ("k" est un raccourci pour les milliers ; "M" est un raccourci pour les millions).

La performance des aéroports de classe 1 dans leur ensemble peut être expliquée par une faiblesse structurelle, plutôt que par le fait que la période de transition n'est pas adéquate. Une telle interprétation est conforme à la fois à la revue de la littérature et à une deuxième source complémentaire de données probantes. Les données d'Eurostat sur les passagers de tous les aéroports de l'UE montrent non seulement que les aéroports de classe 1 ont connu une évolution de trafic assez stable au cours de la période 2010-2018, mais aussi qu'en moyenne, ces aéroports ne dépassent que rarement le seuil de 200,000 annuels. Il pourrait en être de même pour les quelques aéroports de la classe 2 qui ne devraient pas atteindre l'équilibre d'ici 2024.

Toutefois, la remise en cause de l'adéquation de la période transitoire – ainsi que de l'intensité de l'aide – pour les aéroports appartenant à la classe 1 a perdu une grande partie de sa pertinence puisqu'en 2017, la Commission, comme mentionné ci-dessus, a étendu le RGEC aux aides au fonctionnement accordées aux aéroports dont le trafic annuel de passagers est inférieur à 200 000. Par conséquent, depuis 2017, tant que les conditions de compatibilité demeurent inchangées, ces aéroports peuvent recevoir des aides au fonctionnement jusqu'à 100 % de leurs pertes d'exploitation, avant et après 2024.

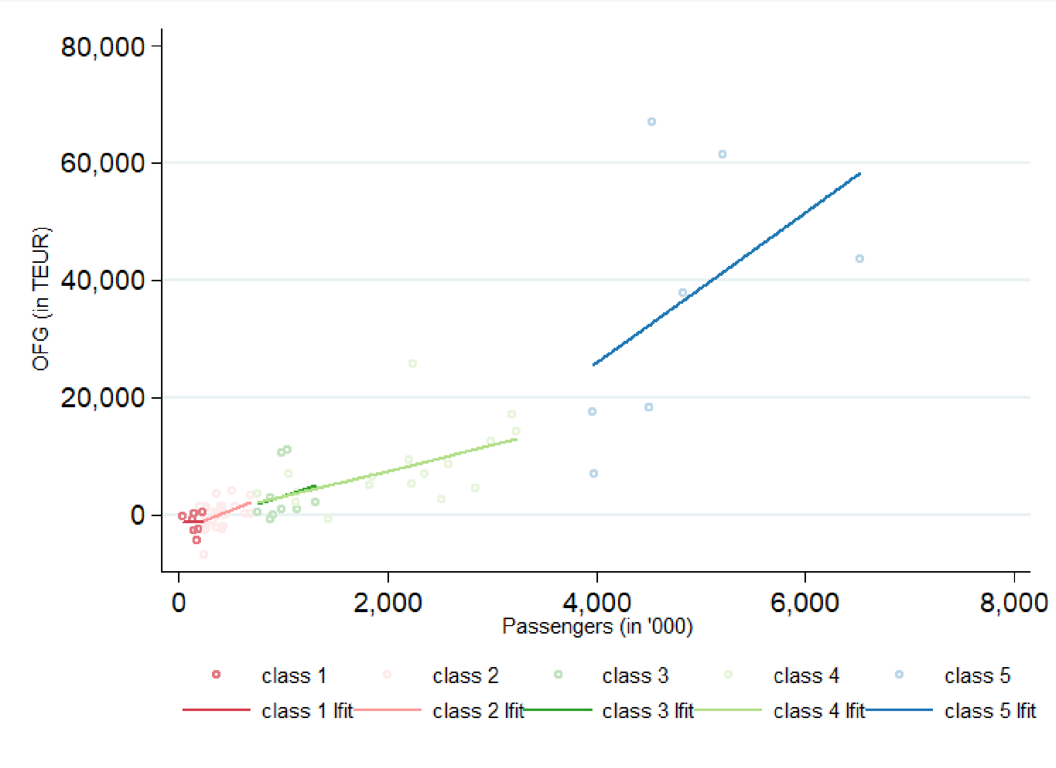
L'étude examine également l'adéquation de l'intensité des aides au fonctionnement pour répondre aux besoins de financement temporaires des aéroports d'ici 2024 pour les aéroports qui dépassent le seuil de 200,000 passagers par an, qui sont pleinement soumis aux règles des lignes directrices pour le transport aérien, sur lesquelles se concentre l'étude. Pour ces aéroports, il existe une intensité d'aide maximale, c'est-à-dire un pourcentage de l'aide pouvant être couverte par l'EFF initial moyen (l'EFF initial moyen correspond à la moyenne annuelle du total des EFF communiqués pendant les cinq années précédant la période transitoire). L'intensité maximale de l'aide dépend du nombre de passagers : i) les aéroports de plus de 200,000 à 700,000 passagers peuvent recevoir jusqu'à 80 % de leur EFF initial ; ii) les aéroports de 700,001 à 3 millions de passagers peuvent recevoir jusqu'à 50 % de leur EFF initial ; les aéroports de plus de 3 millions de passagers ne sont pas éligibles aux aides au fonctionnement. L'analyse descriptive montre que l'exclusion des aéroports de plus de 3 millions de passagers de l'accès aux aides au fonctionnement est justifiée, car ils affichent toujours un EFF positif, tant avant que pendant la période transitoire. Parmi les autres aéroports, tous ceux qui peuvent bénéficier d'une aide à hauteur de 50% de leur EFF initial, bien que ce dernier ait été négatif avant le début de la période transitoire, ne présentent aucun besoin de financement par la suite (car cette intensité n'a restreint aucun d'entre eux). En ce qui concerne les aéroports pouvant bénéficier d'une intensité d'aide de 80 %, le droit maximal à une aide au fonctionnement serait insuffisant pour couvrir entièrement les besoins d'une minorité seulement (23 %) de l'ensemble des aéroports appartenant à ce groupe.

(3) Adéquation de la catégorisation des aéroports

L'évaluation de l'adéquation de la catégorisation des aéroports en fonction du trafic de passagers implique plusieurs questions interdépendantes, à savoir : si le nombre de passagers est un facteur pertinent pour établir la nécessité d'une aide au fonctionnement ; s'il est également suffisant ; et si les seuils actuellement appliqués pour différencier l'intensité des aides au fonctionnement sont appropriés et, dans la négative, quelle catégorisation devrait être adoptée.[4] Pour répondre à ces questions, nous nous sommes appuyés sur des données historiques (2010-2018) plutôt que sur des attentes (2019-2024), ces dernières étant plus spéculatives.

L'analyse effectuée dans le cadre de l'étude montre que les passagers sont certainement importants pour la rentabilité d'un aéroport, ce qui confirme les résultats de la littérature existante. En outre, la corrélation positive entre le trafic de l'aéroport et sa rentabilité, telle que mesurée par l'EFF, est d'autant plus forte que la taille de l'aéroport en termes de passagers est importante (voir Figure 3). Cette corrélation persiste même après avoir tenu compte d'autres facteurs qui semblent être d'importants dans la détermination de la rentabilité.

Figure 3 Relation entre EFF (ou OFG) et passagers. Valeurs moyennes sur la période 2015-2018



Source : données d'échantillon de l'équipe. Note : l'EFF (OFG) est l'écart de financement de fonctionnement au niveau de l'aéroport. Les aéroports sont regroupés en 5 classes selon le nombre de passagers (en milliers : classe 1 : 0-200 ; classe 2 : 200-700 ; classe 3 : 700-1,000 ; classe 4 : 1,000-3,000 ; classe 5 : >3,000). «lfit» est un raccourci pour «ajustement linéaire», une droite représentant la meilleure prédiction linéaire de la variable rapportée sur l'axe vertical (EFF) par la variable rapportée sur l'axe horizontal (passagers). «TEUR» est un raccourci pour milliers d'euros.

[4] Comme indiqué plus haut, les aéroports peuvent être regroupés en différents niveaux actuels d'intensité des aides au fonctionnement, en fonction du nombre annuel de passagers : (i) une intensité d'aide de 100% pour les aéroports jusqu'à 200,000 passagers (ce seuil n'est devenu pertinent que depuis 2017, en raison de l'extension du RGEC) ; (ii) une intensité d'aide de 80% pour les aéroports dépassant 200,000 passagers et jusqu'à 700 000 passagers ; (iii) une intensité d'aide de 50% pour les aéroports dépassant 700,000 et jusqu'à 3 millions de passagers. Les aéroports de plus de 3 millions de passagers n'ont pas accès à des aides aux fonctionnement.

En ce qui concerne la première question, les résultats de nos analyses montrent clairement que le nombre de passagers est en corrélation positive avec la moyenne EFF sur la période de l’échantillon: un volume plus élevé de passagers est lié à une rentabilité plus élevée. Toutefois, pour en venir à la deuxième question, il semble y avoir une certaine hétérogénéité au sein de chaque classes et entre celles-ci.

L’analyse typologique et les analyses économétriques montrent en outre clairement que d’autres facteurs peuvent avoir un impact pertinent sur la définition du besoin d’aide. Les plus importants sont la part des passagers provenant des CBP, du ratio des primes versées aux compagnies aériennes par passager et de l’attractivité des zones où sont situés les aéroports. Toutefois, il n’est pas simple de les inclure pour établir la nécessité d’une aide au fonctionnement. En particulier, il est démontré que la part des passagers des CBP diminue la rentabilité des passagers dans les aéroports les plus petits. Cette preuve est étayée par le fait que les petits aéroports comptent une très forte proportion de passagers provenant de CBP. Deuxièmement, les incitations aux compagnies aériennes semblent également réduire la rentabilité. Troisièmement, les conditions locales jouent également un rôle : les aéroports situés dans des zones plus riches et mieux desservies sont plus rentables. La littérature existante indique que d’autres caractéristiques du marché, que nous n’avons pas pu évaluer dans notre Étude, telles que le pouvoir de marché et la congestion, la réglementation des prix, le pouvoir de négociation à l’égard des transporteurs aériens et le type de trafic que l’aéroport attire sont des caractéristiques pertinentes ayant une incidence sur la rentabilité.

Si l’on se concentre sur les différences à l’intérieur des classes, puisque la plupart des aéroports de classe 1 ne parviennent jamais à être rentables, le nombre de passagers semble être un indicateur suffisant de la rentabilité jusqu’à 200,000 passagers. Si l’on examine les différences au sein de la classe 2, d’autres facteurs que le nombre total de passagers (en particulier la part des passagers de CBP), aident à expliquer pourquoi certains aéroports de la classe 2 parviennent à devenir rentables alors que d’autres non. La plupart des aéroports des classes 3 et 4 (tous deux sous le niveau actuel d’intensité d’aide de 50 %) étaient déjà rentables sur la période 2015-2018 (ils devraient tous l'être d'ici 2024 même si tous ne l’étaient pas dans le passé); ainsi, compte tenu de ces éléments, le volume de passagers pourraient être suffisants pour prévoir leurs besoins de financement. Toutefois, on constate également des différences significatives au sein de ces deux classes sur la période 2015-2018. Ces différences « à l’intérieur de classes » sont liées à la part des passagers des CBP et à l’attractivité des zones où sont situés les aéroports. Enfin, les très grands aéroports (plus de 3 millions de passagers par an) sont toujours rentables. Par conséquent, le volume de passagers semble être suffisant pour identifier leur besoin (ou plutôt, leur absence de besoin) d’aides au fonctionnement.

Ces informations nous permettent de déterminer si le volume de passagers est suffisant pour établir la nécessité d’une aide au fonctionnement. Outre les plus petits aéroports dont le trafic annuel est inférieur à 200,000 passagers (et pour ceux qui sont toujours rentables au-delà de 3 millions de passagers par an), il existe d’autres facteurs qui peuvent fournir des informations utiles sur la viabilité des aéroports et aider à prévoir leurs besoins financiers. Toutefois, outre l’attractivité et la connectivité de la région desservie par l'aéroport, tous les autres facteurs pertinents sont au moins en partie affectés par les choix stratégiques des aéroports eux-mêmes. En tant que telles, elles peuvent être utilisées pour conditionner l’aide et sont moins appropriées pour définir une catégorisation différente de l’intensité de l’aide.

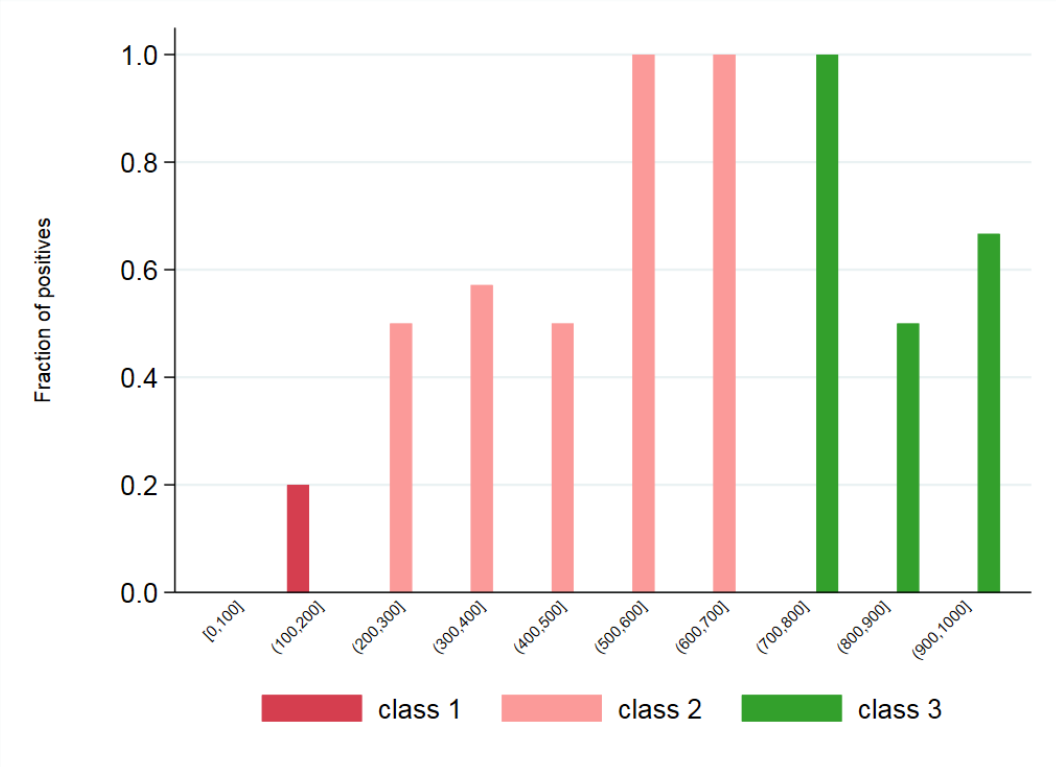
En ce qui concerne la dernière question sur la pertinence de la catégorisation actuelle des aéroports adoptée en 2014 aux fins de définition des intensités d'aide, l'étude montre que la catégorisation plus fine en cinq catégories (catégorie 1 : 0-200 000 ; catégorie 2 : 200 001-700 000 ; catégorie 3 : 700 001-1 million ; catégorie 4 : 1 000 001-3 millions ; et catégorie 5 : au-dessus de 3 millions) aurait pu constituer un meilleur indicateur de la capacité des aéroports à couvrir leurs coûts de fonctionnement, et que cette dernière pourrait encore être améliorée.

Tout d’abord, notre analyse indique qu’il y a un seuil clair à 200,000 passagers, en dessous duquel il est très peu probable qu’un aéroport soit financièrement viable. La grande diversité des aéroports de moins de 200,000 passagers par rapport à tous les autres aéroports est étayée par une analyse descriptive, une analyse typologique et des résultats de régression.

On peut le voir à travers un simple graphique de la variation de l’EFF selon les différents niveaux de passagers annuels, où les différences entre la classe 1 et la classe 2 sont assez évidentes (voir Figure 4 ; seuls les résultats jusqu’à 1 million de passagers sont rapportés car, au-dessus de ce niveau, l’EFF moyen est presque toujours supérieur à zéro). Les aéroports dont le trafic de passagers se situe entre 200 001 et 300 000 passagers semblent déjà très différents de ceux qui se situent en dessous de cette fourchette ; en fait, une part importante d’entre eux (près de 50 %) ont un EFF positif. Ainsi, la classe 1 semble effectivement identifier un groupe d’aéroports qui sont différents des autres aéroports. Toutefois, ce seuil est déjà traité dans le régime actuel d’intensité d’aides au fonctionnement depuis 2017, par l’extension du RGEC.

Deuxièmement, alors qu’à partir de 300,001 passagers, la médiane de la répartition EFF est toujours supérieure à zéro et les différences au sein des classes 2 et 3 sont moins prononcées; les aéroports dont le trafic se situe entre 200,001 et 500,000 passagers sont assez semblables en termes de fraction de seuil de rentabilité ; en même temps, ils semblent différents des aéroports dont le trafic se situe entre 500,001 et 700,000, bien que tous ces aéroports soient regroupés en classe 2. D’après la Figure 4, il semblerait que les aéroports dont le trafic se situe entre 800,001 et 900,000 (ou 900,001 et 1 million) passagers soient également différents des autres aéroports de leur classe. Cependant, tous ces aéroports devraient avoir une moyenne EFF positive sur la période 2019-2024 (la fraction du seuil de rentabilité est de 100% en 2024). Les grandes catégories affichent toutefois une fraction très similaire d'aéroports avec un EFF positif.

Figure 4 Fraction des aéroports dont l'EFF est positif (sur la base des valeurs moyennes sur la période 2015-2018), selon différents seuils de passagers (en milliers de passagers)



Source : données d'échantillon de l'équipe. Note : L'EFF est l'écart de financement de fonctionnement au niveau de l'aéroport. Les aéroports sont regroupés en 5 classes selon le nombre moyen de passagers en 2015-2018 (en milliers: classe 1 : 0-200 ; classe 2 : 200-700 ; classe 3 : 700-1,000 ; classe 4 : 1,000-3,000 ; classe 5 : >3,000). Différentes couleurs identifient différentes classes. Ce chiffre est limité aux aéroports dont le nombre moyen de passagers en 2015-2018 ne dépassera pas 1 million de passagers.

ZUSAMMENFASSUNG (DE)

Kontext

Im Januar 2019 leitete die Europäische Kommission ("Kommission") die Evaluierung der Vorschriften ein, die im Rahmen des Pakets zur Modernisierung der staatlichen Beihilfen von 2012 sowie der Eisenbahnleitlinien und der Mitteilung der Kommission über kurzfristige Exportkreditversicherungen erlassen wurden.[5] Die Evaluierung geht der Frage nach, ob die Rechtsakte künftig weiter verlängert oder aktualisiert werden sollten. Vor diesem Hintergrund hat die Kommission einem Konsortium unter der Leitung von Lear sowie den weiteren Mitgliedern DIW Berlin und Sheppard Mullin ("Team") beauftragt, eine retrospektive Evaluierungsstudie ("Studie") über die Betriebsbeihilfen für Flughäfen nach den seit 2014 geltenden Leitlinien für staatliche Beihilfen für Flughäfen und Luftverkehrsgesellschaften, die in der Mitteilung der Kommission 2014/C 99/03 verabschiedet wurden ("Luftverkehrsleitlinien"), zu erstellen. Nach den Luftverkehrsleitlinien sollen Flughäfen ihre Betriebskosten in der Regel selbst tragen. Dennoch können Regionalflughäfen (mit einem jährlichen Fluggastaufkommen von bis zu 3 Millionen Passagieren) aufgrund ihres Beitrags zur Konnektivität der Bürger und zur regionalen Entwicklung für einen Übergangszeitraum von zehn Jahren, der am 3. April 2024 endet, Betriebsbeihilfen erhalten. Dadurch soll es kleinen Flughäfen ermöglicht werden, sich an das schrittweise Auslaufen der Betriebsbeihilfen unter Berücksichtigung der vielen Veränderungen, die die Branche seit der Liberalisierung des Luftverkehrs im Jahr 1997 durchlaufen hat, anzupassen.

Die Kommission geht in den Luftverkehrsleitlinien davon aus, dass die Rentabilitätsaussichten der Flughäfen je nach Größe (im Hinblick auf den jährlichen Fluggastverkehr) aufgrund der zunehmenden Größenvorteile, die die Branche auszeichnen, sehr unterschiedlich sind. Größere Flughäfen werden mit einem sinkenden Finanzbedarf in Verbindung gebracht. Die Kommission unterscheidet fünf Gruppen von Flughäfen, die sich aufgrund ihres jährlichen Passagieraufkommens unterscheiden ("Kategorien"): Kategorie 1: 0-200.000, Kategorie 2: 200.001-700.000, Kategorie 3: 700.001-1 Million, Kategorie 4: 1.000.001-3.000.000.000 und Kategorie 5: über 3 Millionen. Die Bestimmungen der Luftverkehrsleitlinien verknüpfen die Höchstintensität der Betriebsbeihilfen, die während des Übergangszeitraums zulässig ist, mit der Anzahl der Passagiere, wobei kleinere Flughäfen von einer höheren Beihilfeintensität profitieren können als größere Flughäfen. Darüber hinaus hat die Kommission im Jahr 2017 den Anwendungsbereich der Allgemeinen Gruppenfreistellungsverordnung (AGVO) auf Betriebsbeihilfen für Flughäfen mit weniger als 200.000 Fluggästen pro Jahr ausgeweitet. Daher gelten Betriebsbeihilfen für diese Flughäfen seit 2017 als mit dem EU-Binnenmarkt vereinbar. Infolgedessen können diese Flughäfen Betriebsbeihilfen erhalten, um bis zu 100% ihrer Betriebsverluste vor und nach 2024 zu decken.

Zielsetzung

Mit der Studie soll der Kommission eine unabhängige, evidenzbasierte Bewertung der Luftverkehrsleitlinien vor dem Hintergrund von drei Evaluierungsfragen vorgelegt werden: (1) Können regionale Flughäfen zur regionalen Entwicklung beitragen ("Beitrag der Regionalflughäfen

[5] Mitteilung der Kommission an das Europäische Parlament, den Rat, den Europäischen Wirtschafts- und Sozialausschuss und den Ausschuss der Regionen, Modernisierung des EU-Beihilfenrechts, COM(2012) 209 final.

zur regionalen Entwicklung"); (2) Ist der in den Luftverkehrsleitlinien vorgesehene Übergangszeitraum (2014-2024) für das Auslaufen von Betriebsbeihilfen angemessen, so dass die Flughäfen eine kostendeckende Betriebsleistung erbringen können („Angemessenheit des Übergangszeitraums"; (3) Ist die Kategorisierung der in den Luftverkehrsleitlinien vorgesehenen Flughäfen zur Feststellung der Notwendigkeit von Betriebsbeihilfen geeignet und erfüllen die Schwellenwerte der Beihilfeintensität in den Luftverkehrsleitlinien ihren Zweck („Angemessenheit der Kategorisierung von Flughäfen").

Angewandte Methodiken und Maßnahmen

Im Rahmen der Studie wurden mehrere Methodiken angewandt. Zunächst stützt sich die Studie auf eine Auswertung der einschlägigen Literatur, um den Beitrag der Regionalflughäfen zur regionalen Entwicklung auszuwerten. Zweitens stützt sich die Untersuchung im Hinblick auf die anderen beiden Fragen der Studie auf statistische und ökonometrische Analysen sowie Clusteranalysen unter Verwendung von Flughafendaten über die bisherige und erwartete finanzielle Leistungsfähigkeit sowie über den jährlichen Fluggastverkehr.

Zu diesem Zweck wurden mittels einer Umfrage auf Flughafenebene Daten in verschiedenen Ländern erhoben. Das Ergebnis der Untersuchung basiert auf Antworten von 68 Flughäfen aus 11 Mitgliedstaaten. Die gesammelten Daten umfassen die Finanzen und Eigenschaften der Flughäfen für den Zeitraum 2010-2018 sowie Prognosen für den Zeitraum 2019-2024, und umfassen unter anderem Informationen über öffentliche Mittel, die für verschiedene Zwecke bestimmt sind, die Anzahl, Art und den Umsatzanteil der an den Flughäfen operierenden Fluggesellschaften, das Geschäftsmodell der Flughäfen sowie die Charakterisierung des Einzugsgebiets der Flughäfen. Zudem wurden die von Eurostat verfügbaren Regionalstatistiken über BIP, Bevölkerung und Beschäftigung auf der Ebene der NUTS-3-Regionen (die feinste Ebene der geografischen Regionen) als Bewertungsmaßstab für die Entwicklung des Einzugsgebiets verwendet, in dem sich die Flughäfen befinden. Berücksichtigt wurden zudem die von Eurostat erhobenen jährlichen Passagierdaten für alle Flughäfen in der Europäischen Union ("EU").

Bei sämtlichen quantitativen Analysen wird die Flughafenleistung anhand der operativen Finanzierungslücke gemessen, die in den Luftverkehrsleitlinien zur Quantifizierung des Finanzbedarfs von beihilfefähigen Flughäfen verwendet wird. Die operative Finanzierungslücke berechnet sich aus dem "Ergebnis vor Zinsen, Steuern und Abschreibungen" ("EBITDA") abzüglich aller öffentlichen Mittel im Hinblick auf die Betriebskosten. Nur bei einer negativen operativen Finanzierungslücke während des Übergangszeitraums kommen Betriebsbeihilfen in Betracht. Eine positive operative "Finanzierungslücke" gibt es eigentlich nicht. Ziel der Studie ist es jedoch, beurteilen zu können, inwieweit Flughäfen bis zum Ende des Übergangszeitraums rentabel sein dürften, so dass der Begriff operative Finanzierungslücke („OFL") als Maßeinheit für die Rentabilität verwendet wird, der als solcher negativ (bei Betriebsverlusten) oder positiv (bei Betriebserträgen, die Betriebskosten decken) sein kann.

Auswertung der Evaluierungsfragen

(1) Der Beitrag der Regionalflughäfen zur regionalen Entwicklung

Es wurden drei relevante Literaturstränge berücksichtigt, um die Frage des Beitrags der Regionalflughäfen zur regionalen Entwicklung zu untersuchen. Erstens überprüfte das Team die Literatur zur Ökonomie der Flughäfen und untersuchte die potenziellen Bestimmungsfaktoren der

Rentabilität von Flughäfen: Größe des Luftverkehrs, Eigentümerstruktur, Nähe zu anderen Flughäfen und anderen Verkehrsinfrastrukturen sowie wirtschaftliche Anreize zur Gewinnung von Fluggesellschaften und die Abhängigkeit von Billigfluggesellschaften (Low cost carriers, "LCCs"). Die beiden letztgenannten Faktoren sind seit der Liberalisierung des Luftverkehrs innerhalb der EU im Jahr 1997 von zentraler Bedeutung. Dieser erste Literaturstrang liefert auch Hintergrundinformationen für die Beurteilung der beiden anderen Evaluierungsfragen. Die vorliegenden Erkenntnisse bestätigen den positiven Zusammenhang zwischen der Größe der Flughäfen und der technischen und wirtschaftlichen Effizienz, auch wenn sie nicht darauf hindeuten, dass es eine Mindestgröße für die Kostendeckung von Flughäfen gibt. Regionalflughäfen sind oft mit einer begrenzten Nachfrage konfrontiert, und es wird sicherlich Flughäfen geben, die – obwohl effizient betrieben – nicht genügend Geschäft generieren, um ihre Betriebskosten zu decken. Kleine Flughäfen sind oft einer hohen Saisonalität der Nachfrage ausgesetzt, was die Effizienz weiter beeinträchtigt. Es gibt unterschiedliche Erkenntnisse im Hinblick auf die Vorteile eines privaten Managements eines Flughafens im Vergleich zum öffentlichen Management, sowohl bei der Betrachtung der Kosteneffizienz als auch bei der Höhe der Flughafenentgelte. Darüber hinaus stehen der in einigen Publikationen festgestellte Zusammenhang zwischen Privatisierung und Effizienz nicht unbedingt in Kausalität zueinander, solange private Investoren in "bessere" Flughäfen investieren. Die möglichen Auswirkungen des Wettbewerbs zwischen den Flughäfen sind zweiseitig: Er kann die Effizienz steigern oder aber zu einer Kannibalisierung der Nachfrage im Luftverkehr führen, wenn die Nachfrage im Verhältnis zur Größe des lokalen Angebots im Luftverkehr begrenzt ist. Die vorliegenden Erkenntnisse deuten auf einen Wettbewerb zwischen den Flughäfen hin, der zu einer höheren Effizienz führt, was jedoch darauf zurückzuführen sein könnte, dass es in gut vernetzten größeren Metropolregionen möglich ist, mehrere Flughäfen in ausreichendem Umfang zu betreiben. Darüber hinaus sind die Erkenntnisse über die Auswirkungen des LCC-Anteils am Luftverkehr auf Flughafenebene nach wie vor gering; wenn Flughäfen um die Dienstleistungen der Fluggesellschaften konkurrieren, könnten Anreizprogramme langfristig nicht nachhaltig sein und die Rentabilität verringern, da die LCCs über eine größere Verhandlungsmacht im Umgang mit kleinen Flughäfen verfügen. Zudem scheinen die LCCs sich zunehmend von kleinen Flughäfen an die mittelgroßen Flughäfen zu wenden, um Geschäftsreisende anzuziehen. Auch das regulatorische Umfeld könnte ein wichtiger Faktor für die Effizienz von Flughäfen sein, insbesondere wenn die Flughäfen keinem Wettbewerbsumfeld ausgesetzt sind.

Der zweite Literaturstrang untersucht den Zusammenhang zwischen Luftverkehr und regionaler Entwicklung. Auch wenn in vielen Publikationen einfach von einem kausalen Zusammenhang zwischen Luftverkehr und regionaler Entwicklung ausgegangen wird, liefern einige nennenswerte Ausnahmen empirische Hinweise darauf, dass sich der (zunehmende) Luftverkehr tatsächlich positiv auf das Wirtschaftswachstum auswirkt. Insgesamt bestätigen diese Studien einen positiven Effekt für die Gesamtwirtschaft und speziell für die Dienstleistungsbranche. Berücksichtigt wurden die Bereiche Beschäftigung, Bruttoinlandsprodukt ("BIP") und Handel. Einige Studien haben ergeben, dass die Auswirkungen für die entlegensten Gebiete, die über alternative Verkehrsinfrastrukturen nicht erreichbar sind, besonders ausgeprägt sind und dass diese Regionen im Vergleich zu anderen geografischen Gebieten besonders stark beeinträchtigt sind. Dabei muss aber beachtet werden, dass die gefundenen Effekte in den meisten Fällen den Durchschnitt aller Flughäfen abbilden, da sich keine Studien speziell auf Regionalflughäfen konzentrieren.

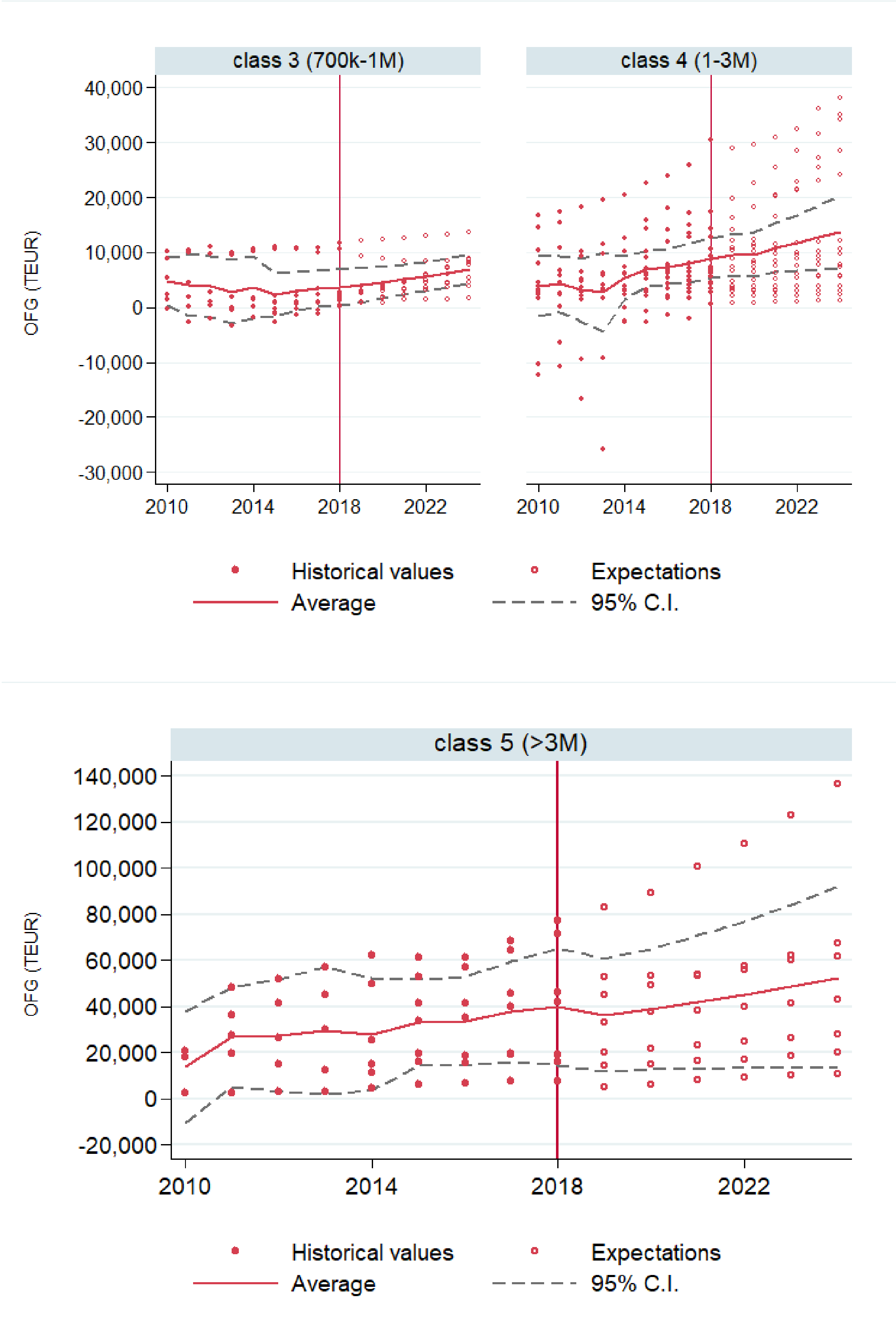
Das Team hat die Literatur auch im Hinblick auf die Auswirkungen öffentlicher Zuschüsse auf Regionalflughäfen untersucht. Die Erkenntnisse hierzu sind aber zu gering, um zuverlässige

Rückschlüsse zu ziehen. Dennoch kann man die Erkenntnisse aus den beiden anderen Literatursträngen nutzen, um einige Schlussfolgerungen zu ziehen. Insgesamt scheinen kleinere Regionalflughäfen in irgendeiner Form langfristige öffentliche Unterstützung zu benötigen, um auf dem Markt bestehen zu können. Daher stellt sich die Frage, ob eine solche Unterstützung durch die positiven wirtschaftlichen Auswirkungen dieser Flughäfen auf ihre jeweiligen Regionen gerechtfertigt werden kann. Während positive externe Effekte, wie Agglomerations- oder Konnektivitätsvorteile, eher mit den großen Flughäfen als mit kleineren Regionalflughäfen in Verbindung gebracht werden, kann aus den Erkenntnissen über die Auswirkungen des Luftverkehrs auf die regionale Entwicklung geschlossen werden, dass es einen besonderen sozioökonomischen Nutzen hat, Einwohner abgelegener und weniger erschlossener Gebiete über den Luftverkehr an das größere regionale oder nationale Netz für Gesundheits-, Bildungs- oder Geschäftszwecke anzubinden. Natürlich sollte die Frage der finanziellen Unterstützung von Regionalflughäfen im Lichte der verfügbaren Erkenntnisse über die Faktoren, die sich auf die Effizienz und/oder Rentabilität der Flughäfen auswirken, berücksichtigt werden, damit die Beihilfen die richtigen Anreize für ein effizientes Management bieten sowie die Duplizierung der Infrastruktur und Überkapazitäten vermeiden. Schließlich legt die Literatur nahe, dass eine fundierte Kosten-Nutzen-Analyse der Nutzung öffentlicher Ressourcen nicht außer Acht lassen sollte, dass ein verbesserter Zugang zu einer Region negative wirtschaftliche Auswirkungen auf andere Regionen haben kann. Zudem sollte es Opportunitätskosten für Mittel zur Unterstützung der lokalen Flughafeninfrastruktur geben, und diese Opportunitätskosten sollten die negativen Externalitäten des Luftverkehrs in Bezug auf Luftverschmutzung, Lärm und andere Umweltaspekte im Hinblick auf alternative (bestehende oder potenzielle) Verbindungwege von Regionen umfassen.

(2) Angemessenheit des Übergangszeitraums

Die Erwartungen sind dergestalt, dass alle Flughäfen über 700.000 Passagiere (Kategorien 3, 4 und 5) in der Lage sein sollten, ihre Betriebskosten bis 2024 vollständig zu tragen (d.h. um ein finanzielles Gleichgewicht zu erreichen: Abbildung 1 zeigt die zeitliche Entwicklung der OFL für Flughäfen, die zu diesen Kategorien gehören). Sowohl bei den Umfragedaten als auch bei den Eurostat-Daten für alle EU-Flughäfen weisen die Kategorien 3, 4 (und 5) ein größeres Wachstumspotenzial auf als kleinere Kategorien. Die Eurostat-Daten deuten insbesondere darauf hin, dass diese Flughäfen dazu neigen, sich schnell über ihre kategoriebezogenen Grenzen hinaus zu vergrößern. Dies deutet insgesamt darauf hin, dass die Dauer des Übergangszeitraums für Flughäfen mit mehr als 700.000 Passagieren ausreichend erscheint.

Abbildung 1 Entwicklung der operativen Finanzierungslücke (Englisch: OFG) für Flughäfen der Kategorien 3 bis 5

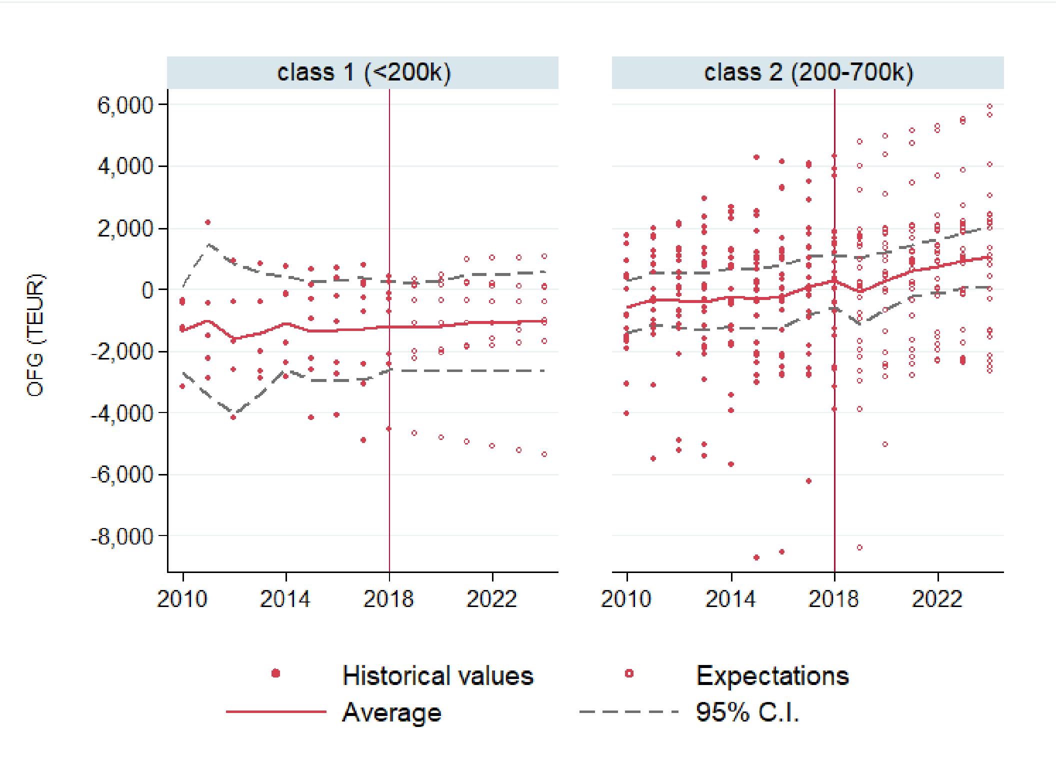


Quelle: Team auf Basis von Umfragedaten. Die roten Kreise stellen alle Daten des Flughafenjahres dar. Die rote Linie stellt den Mittelwert dar, die gestrichelten grauen Linien stellen das 95% Konfidenzintervall für den Mittelwert dar (C.I.). Kategoriegrenzen werden in Klammern über jedem Diagramm angegeben ("k" steht für Tausende; "M" bedeutet Millionen). Flughäfen werden in 5 Kategorien nach Passagieren eingeteilt (in Tausend: Kategorie 1: 0-200; Kategorie 2: 200-700; Kategorie 3: 700-1.000; Kategorie 4: 1.000-3.000; Kategorie 5: >3.000). Kategoriegrenzen werden in Klammern über jedem Diagramm angegeben. "k" ist eine Abkürzung für Tausend; "M" ist eine Abkürzung für Millionen; „TEUR" ist eine Abkürzung für Tausend Euro.

Abbildung 2 zeigt die zeitliche Entwicklung der OFL für Flughäfen der Kategorien 1 und 2. Die Mehrheit (69%) der Flughäfen der Kategorie 2 (200.001-700.000 Passagiere) wird bis 2024 ein finanzielles Gleichgewicht erreichen können. Zusätzlich werden diejenigen Flughäfen, die bis 2024 nicht in einem solchen Gleichgewicht sein dürften, einen verbesserten Trend insbesondere im Vergleich zu einem Rückgang im Jahr 2019 aufzeigen. Diese Ergebnisse deuten darauf hin, dass der Übergangszeitraum für die Mehrheit der Flughäfen der Kategorie 2 ausreichend ist, um ein finanzielles Gleichgewicht zu erreichen, und dass sie sich im Durchschnitt in Richtung finanzielles Gleichgewicht bewegen. Es ist jedoch nicht vorhersehbar, ob die wenigen Flughäfen in dieser Klasse, die das Ziel bis 2024 nicht erreichen werden, irgendwann in der Zukunft eine positive OFL erzielen können, da die einzelnen Verhaltensmuster unterschiedlich sind.

Ein anderes Ergebnis ergibt sich für die Flughäfen der Kategorie 1 (bis zu 200.000 Passagiere): Erstens können nur 37.5 % das finanzielle Gleichgewicht erreichen. Zweitens zeigen sie meistens rückläufige OFL-Trends (sowohl diejenigen, die 2024 im finanziellen Gleichgewicht sind, als auch diejenigen, die es nicht sind). Die in dieser Studie vorgelegten Erkenntnisse lassen auch den Schluss zu, dass keiner der Flughäfen der Kategorie 1, der Betriebsbeihilfen erhalten hat, im Jahr 2024 ein finanzielles Gleichgewicht erreichen dürfte.

Abbildung 2 Entwicklung der operativen Finanzierungslücke (Englisch: OFG) für Flughäfen der Kategorien 1 und 2



Quelle: Team auf Basis von Umfragedaten. Hinweis: Die roten Kreise stellen alle Daten des Flughafenjahres dar. Die rote Linie stellt den Mittelwert dar, die gestrichelten grauen Linien stellen das 95% Konfidenzintervall für den Mittelwert dar (C.I.). Kategoriegrenzen werden in Klammern über jedem Diagramm angegeben ("k" steht für Tausende; "M" bedeutet Millionen). Flughäfen werden in 5 Kategorien nach Passagieren eingeteilt (in Tausend: Kategorie 1: 0-200; Kategorie 2: 200-700; Kategorie 3: 700-1.000; Kategorie 4: 1.000-3.000; Kategorie 5: >3.000). Kategoriegrenzen werden in Klammern über jedem Diagramm angegeben. "k" ist eine Abkürzung für Tausend; "M" ist eine Abkürzung für Millionen; „TEUR" ist eine Abkürzung für Tausend Euro.

Die Leistungsfähigkeit von Flughäfen der Kategorie 1 könnte insgesamt eher von einer strukturellen Schwäche bestimmt sein, weniger entscheidend scheint dabei die Dauer des Übergangszeitraums. Eine solche Interpretation wird sowohl in der Literatur als auch von einer zweiten ergänzenden Beweisquelle gestützt. Die Eurostat-Daten über Fluggäste für alle EU-Flughäfen zeigen nicht nur, dass die Flughäfen der Kategorie 1 im Zeitraum 2010-2018 eine niedrige Verkehrsleistung aufwiesen, sondern weisen auch darauf hin, dass diese Flughäfen im Durchschnitt kaum ein Verkehrsaufkommen von über 200.000 Fluggästen erreichen werden. Dasselbe könnte für die wenigen Flughäfen der Kategorie 2 gelten, von denen erwartet wird, dass sie bis 2024 kein finanzielles Gleichgewicht erreichen werden.

Die Frage nach der Angemessenheit des Übergangszeitraums – ebenso wie die Frage nach die Beihilfenintensität – für Flughäfen der Kategorie 1 hat jedoch weitgehend an Bedeutung verloren, seitdem die Kommission 2017, wie bereits erwähnt, die Allgemeine Gruppenfreistellungsverordnung ("AGVO") auf Betriebsbeihilfen für Flughäfen mit einem jährlichen Passagieraufkommen von weniger als 200.000 Fluggästen ausgedehnt hat. Aufgrund dessen können diese Flughäfen seit 2017, solange sie die Voraussetzungen für die Vereinbarkeit der Beihilfen erfüllen, Betriebsbeihilfen für bis zu 100% ihrer Verluste von und nach 2024 erhalten.

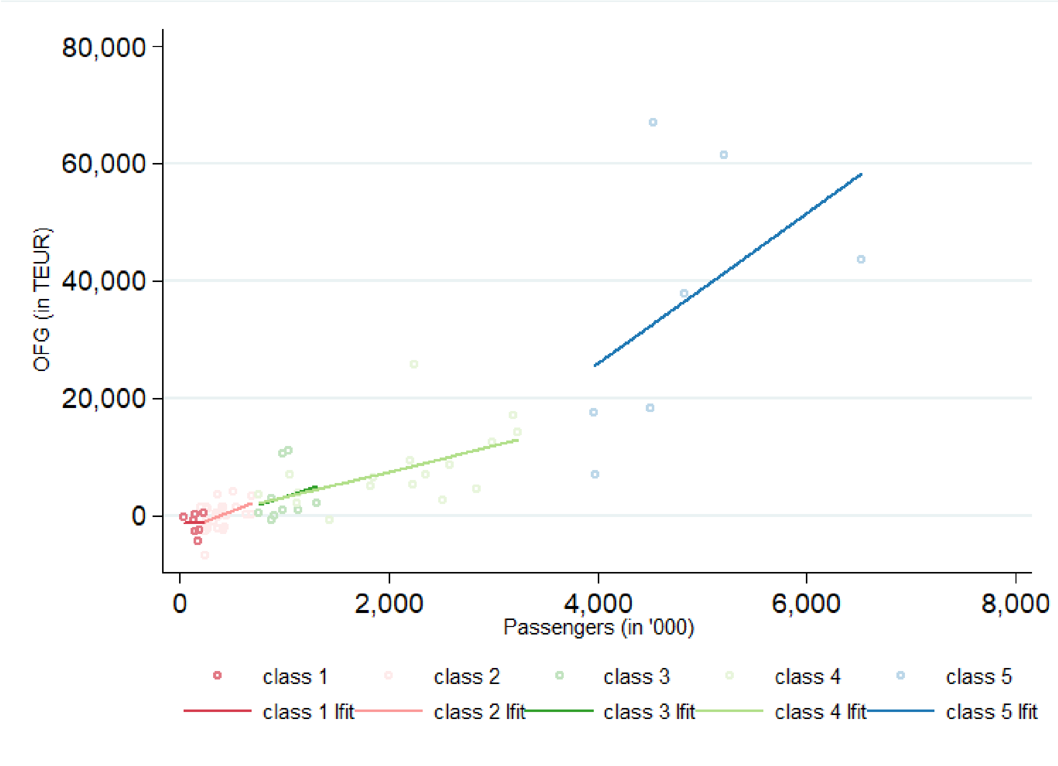
Die Studie untersucht auch die Angemessenheit der Intensität der Betriebsbeihilfen, um den vorübergehenden Finanzierungsbedarf bis 2024 für Flughäfen über der Grenze von 200.000 Passagieren pro Jahr zu decken, die vollständig den Luftverkehrsleitlinien unterliegen und im Fokus der Studie stehen. Für diese Flughäfen gibt es eine maximale Beihilfeintensität, d.h. einen Prozentsatz der durchschnittlichen anfänglichen OFL, die durch eine Beihilfe gedeckt werden kann (die durchschnittliche anfängliche OFL ist der Jahresdurchschnitt der gesamten OFL, die in den fünf Jahren vor dem Übergangszeitraum gemeldet wurde). Die maximale Beihilfeintensität hängt von der Anzahl der Fluggäste ab: (i) Flughäfen über 200.000 und bis zu 700.000 Passagieren können bis zu 80% ihrer anfänglichen OFL erhalten; (ii) Flughäfen zwischen 700.001 und 3 Millionen Passagieren können bis zu 50% ihrer anfänglichen OFL erhalten. Flughäfen mit mehr als 3 Millionen Fluggästen sind von der Gewährung von Betriebsbeihilfen ausgeschlossen. Die deskriptive Analyse zeigt, dass der Ausschluss von Flughäfen über 3 Millionen Fluggästen vom Zugang zu Betriebsbeihilfen gerechtfertigt ist, da sie sowohl vor als auch während des Übergangszeitraums stets eine positive OFL aufweisen. Die übrigen Flughäfen, die Anspruch auf eine Beihilfeintensität von 50% haben, weisen keinen Finanzierungsbedarf mehr auf, obwohl sie vor Beginn des Übergangszeitraums eine negative OFL hatten (die Beihilfeintensität als solche wirkte nicht beschränkend). Bei Flughäfen mit einer Beihilfeintensität von 80% würde der maximale Anspruch auf Betriebsbeihilfen nicht ausreichen, um den Bedarf nur einer Minderheit (23%) aller Flughäfen dieser Gruppe vollständig zu decken.

(3) Angemessenheit der Kategorisierung von Flughäfen

Die Bewertung der Angemessenheit der Kategorisierung von Flughäfen nach dem Passagierverkehr impliziert mehrere miteinander zusammenhängende Fragen: Ist die Zahl der Fluggäste ein relevanter Faktor, um den Bedarf an Betriebsbeihilfen festzustellen; Ist sie ausreichend; Sind die derzeit in den Luftverkehrsleitlinien festgelegten Schwellenwerte für die Differenzierung der Intensität von Betriebsbeihilfen angemessen und, falls nicht, welche Kategorisierung sollte vorgenommen werden.[6] Die Beantwortung dieser Fragen stützt sich auf historische Daten (2010-2018) und weniger auf Erwartungen (2019-2024), da letztere spekulativer sind.

Die in der Studie durchgeführte Analyse zeigt, dass Passagiere sicherlich wichtig für die Rentabilität eines Flughafens sind, was durch die Erkenntnisse aus der Literatur bestätigt wird. Darüber hinaus ist der positive Zusammenhang zwischen dem Verkehrsaufkommen des Flughafens und seiner Rentabilität, gemessen an der OFL, umso stärker, je größer der Flughafen im Hinblick auf das Passagieraufkommen ist (siehe Abbildung 3). Diese Korrelation bleibt auch nach der Heranziehung anderer Faktoren bestehen, die wichtige Bestimmungsfaktoren für die Rentabilität zu sein scheinen.

Abbildung 3 Verhältnis zwischen OFL (Englisch: OFG) und Passagieren. Durchschnittliche Werte über die Jahre 2015-2018



Quelle: Team auf Basis von Umfragedaten. Hinweis: OF: ist die operative Finanzierungslücke auf Flughafenebene. Flughäfen werden in 5 Kategorien nach Passagieren eingeteilt (in Tausend: Kategorie 1: 0-200; Kategorie 2: 200-700; Kategorie 3: 700-1.000; Kategorie 4: 1.000-3.000; Kategorie 5: >3.000). "lfit" ist eine Abkürzung für "linear fit", eine gerade Linie, die die beste lineare Vorhersage der auf der vertikalen Achse (OFL) gemeldeten Variablen durch die auf der horizontalen Achse gemeldete Variable (Passagiere) darstellt. „TEUR" ist eine Abkürzung für Tausend Euro.

Was die erste Frage betrifft, so zeigen die Ergebnisse unserer Untersuchung deutlich, dass die Anzahl der Passagiere positiv mit der durchschnittlichen OFL über den Umfragezeitraum

[6] Wie bereits erläutert, können Flughäfen in Abhängigkeit von den jährlichen Passagieren in mehrere Regelungen zur Intensität der Betriebsbeihilfen eingeteilt werden: (i) Beihilfeintensität von 100% für Flughäfen mit bis zu 200.000 Passagieren (diese Begrenzung ist erst seit 2017 als Folge der AGVO-Erweiterung relevant geworden); (ii) Beihilfeintensität von 80% für Flughäfen mit mehr als 200.000 und bis zu 700.000 Passagieren; (iii) 50% Beihilfeintensität für Flughäfen mit mehr als 700.000 und bis zu 3 Millionen Passagieren. Flughäfen über 3 Millionen Passagieren können keine Beihilfen erhalten.

korreliert: Mehr Passagiere sind mit einer höheren Rentabilität verbunden. Für die zweite Frage scheint es eine gewisse Heterogenität innerhalb und zwischen den Kategorien zugeben.

Die Clusteranalyse und die ökonometrische Analyse zeigen zudem deutlich, dass andere Faktoren einen relevanten Einfluss auf die Definition des Beihilfebedarfs haben können. Die wichtigsten Faktoren sind der Anteil der Fluggäste der LCCs, das Verhältnis der Anreize, die den Fluggesellschaften pro Fluggast gewährt werden, und die Attraktivität der Gebiete, in denen sich die Flughäfen befinden. Es jedoch nicht einfach, diese Faktoren einzubeziehen, um die Notwendigkeit von Betriebsbeihilfen festzustellen. Insbesondere der Anteil der LCCs an den Passagieren verringert nachweislich die Rentabilität der Passagiere für die kleinsten Flughäfen. Dies wird durch kleine Flughäfen mit einem sehr hohen Anteil an Passagieren aus LCCs bestätigt. Zweitens scheinen auch die Anreize für die Fluggesellschaften die Rentabilität zu verringern. Drittens spielen auch die lokalen Bedingungen eine Rolle: Flughäfen in wohlhabenderen und besser vernetzten Gebieten sind profitabler. Aus der Literatur ergibt sich zudem, dass andere Marktmerkmale wie Marktmacht und Überlastung, Preisregulierung, Verhandlungsmacht gegenüber Luftfahrtunternehmen und die Art des Luftverkehrs, den der Flughafen anzieht, relevant sind und sich auf die Rentabilität auswirken.

Betrachtet man die Unterschiede innerhalb der Kategorien, wobei die meisten Flughäfen der Kategorie 1 nie rentabel sind, scheint die Zahl der Fluggäste ein ausreichender Indikator für die Rentabilität von bis zu 200.000 Fluggästen zu sein. Vergleicht man die Unterschiede innerhalb der Kategorie 2, so sind andere Faktoren als die Anzahl der Passagiere dafür ausschlaggebend (insbesondere der Anteil der LCC-Passagiere), warum einige Flughäfen der Kategorie 2 es schaffen, Gewinne zu erzielen, während andere dies nicht tun. Die meisten Flughäfen der Kategorien 3 und 4 (beide im Rahmen der derzeitigen 50%igen Beihilferegelung) waren im Zeitraum 2015-2018 bereits rentabel (dies wird von allen Flughäfen bis 2024 erwartet, auch wenn dies in der Vergangenheit nicht zutraf); angesichts dieser Erkenntnisse ist es möglich, den Finanzierungsbedarf anhand der Anzahl der Fluggäste zu prognostizieren. Allerdings gibt es auch innerhalb dieser beiden Kategorien im Zeitraum 2015-2018 signifikante Unterschiede. Diese Unterschiede innerhalb der Kategorien hängen mit dem Anteil der LCC-Passagiere und der Attraktivität der Gebiete zusammen, in denen sich die Flughäfen befinden. Schließlich sind sehr große Flughäfen (über 3 Millionen Passagiere pro Jahr) stets profitabel. Daher scheint die Zahl der Fluggäste ausreichend zu sein, um den (fehlenden) Bedarf an Betriebsbeihilfen zu ermitteln.

Mit diesen Erkenntnissen kann ermittelt werden, ob die Zahl der Fluggäste ausreicht, um den Bedarf an Betriebsbeihilfen festzustellen. Abgesehen von den kleinsten Flughäfen mit einem jährlichen Verkehrsaufkommen von unter 200.000 Passagieren (und für diejenigen über 3 Millionen Passagieren pro Jahr, die immer profitabel sind), gibt es weitere Faktoren, die nützliche Erkenntnisse über die Leistungsfähigkeit von Flughäfen liefern und dabei helfen können, den Finanzbedarf der Flughäfen vorherzusagen. Abgesehen von der Attraktivität und der vom Flughafen erschlossenen Region sind jedoch alle anderen relevanten Faktoren zumindest teilweise von den strategischen Entscheidungen der Flughäfen abhängig. Diese Faktoren können daher eher als Bedingungen für die Gewährung von Beihilfen verwendet werden und sind weniger geeignet, eine andere Klassifizierung der Beihilfeintensität vorzunehmen.

Im Hinblick auf die letzte Frage nach der Angemessenheit der ursprünglichen Kategorisierung von Flughäfen, die 2014 für die Festlegung der Beihilfeintensitäten verabschiedet wurde, zeigt die

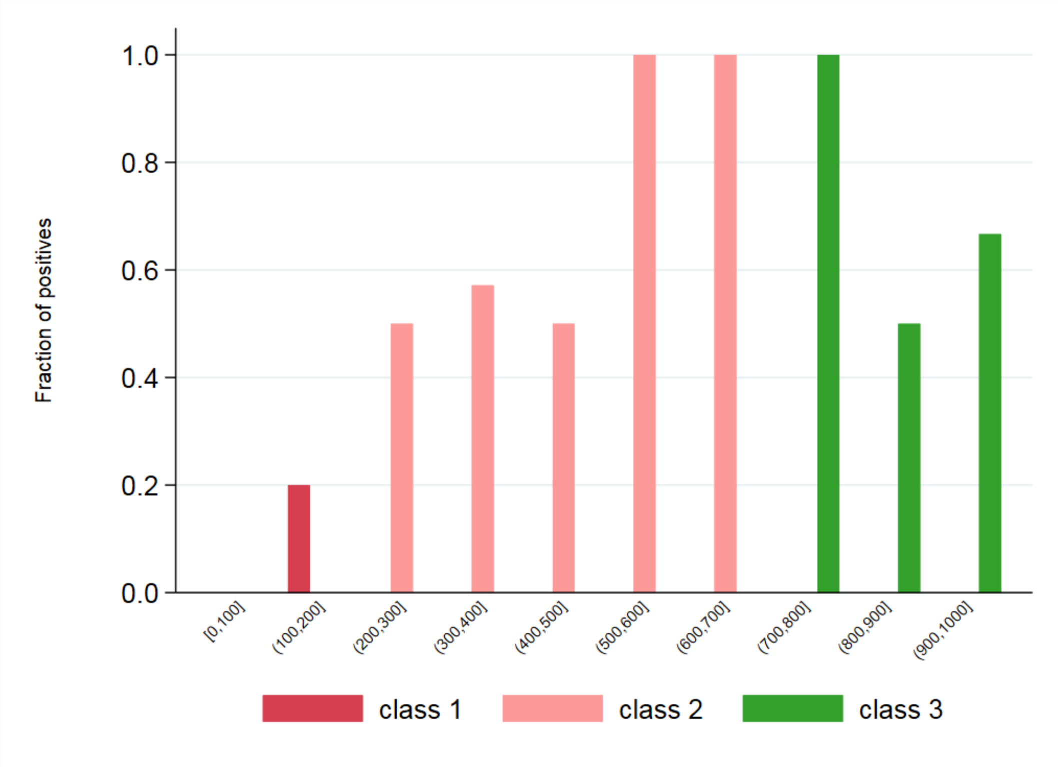
Studie, dass die feinere Fünf-Klassen-Kategorisierung (Kategorie 1: 0-200.000; Kategorie 2: 200.001-700.000; Kategorie 3: 700.001-1 Millionen; Kategorie 4: 1.000.001-3 Millionen; und Kategorie 5: über 3 Millionen) ein besserer Indikator für die Leistungsfähigkeit eines Flughafens gewesen wäre, seine Betriebskosten zu decken, wobei es noch Raum für weitere Verbesserungen gibt.

Erstens zeigt unsere Analyse, dass es bei 200.000 Passagieren eine klare Grenze gibt, unterhalb der es sehr unwahrscheinlich ist, dass ein Flughafen finanziell tragfähig ist. Die ausgeprägte Vielfalt der Flughäfen unter 200.000 Passagieren im Vergleich zu allen anderen Flughäfen wird durch deskriptive Analysen, Clusteranalysen und durch Regressionsergebnisse gestützt.

Anhand einer einfachen Grafik kann veranschaulicht werden, wie die OFL bei verschiedenen Jahrespassagierzahlen variiert, wobei Unterschiede zwischen der Kategorie 1 und Kategorie 2 deutlich zu erkennen sind (siehe Abbildung 4; es werden nur die Ergebnisse von bis zu 1 Million Passagieren berücksichtigt, da oberhalb dieses Niveaus die durchschnittliche OFL fast immer über Null liegt). Flughäfen mit einem Fluggastaufkommen zwischen 200.001 und 300.000 Passagieren stehen schon jetzt finanziell ganz anders dar als die Flughäfen unterhalb dieser Schwelle; ein erheblicher Teil der Flughäfen (fast 50%) weist sogar eine positive OFL auf. Somit scheint die Kategorie 1 tatsächlich eine Gruppe von Flughäfen zu sein, die sich von den anderen Flughäfen unterscheidet. Diese Grenze ist jedoch bereits seit 2017 in der derzeitigen Beihilfeintensität bei den Betriebsbeihilfen als Folge der AGVO-Ausweitung berücksichtigt.

Zweitens liegt der Medianwert der OFL-Verteilung ab 300.001 Passagieren immer über Null und die Unterschiede zwischen Kategorie 2 und Klasse 3 sind weniger ausgeprägt. Flughäfen mit einem Verkehrsaufkommen zwischen 200.001 und 500.000 Passagieren sind jedoch in Bezug auf den Anteil der kostendeckenden Flughäfen recht ähnlich; gleichzeitig scheinen sie sich von Flughäfen mit einem Verkehrsaufkommen zwischen 500.001 und 700.000 zu unterscheiden, obwohl alle diese Flughäfen in der Kategorie 2 zusammengefasst sind. Aus Abbildung 4 kann entnommen werden, dass sich auch Flughäfen mit einem Verkehrsaufkommen zwischen 800.001 und 900.000 (oder 900.001 und 1 Million) Passagieren von anderen Flughäfen ihrer Kategorie unterscheiden. Allerdings wird davon ausgegangen, dass alle diese Flughäfen im Zeitraum 2019-2024 einen positiven OFL-Durchschnitt aufweisen (der Anteil der Gewinnschwelle liegt bis 2024 bei 100%). Größere Kategorien zeigen dagegen einen sehr ähnlichen Anteil von Flughäfen mit einer positiven OFL.

Abbildung 4 Anteil der Flughäfen mit positiver OFL (basierend auf den Durchschnittswerten der Jahre 2015-2018) bei unterschiedlichen Passagierschwellenwerten ('000)



Hinweis: OFL ist die operative Finanzierungslücke auf Flughafenebene. Flughäfen werden in 5 Kategorien nach Passagieren eingeteilt (in Tausend: Kategorie 1: 0-200; Kategorie 2: 200-700; Kategorie 3: 700-1.000; Kategorie 4: 1.000-3.000; Kategorie 5: >3.000). Die Zahl ist auf Flughäfen mit einer durchschnittlichen Passagierzahl in den Jahren 2015-2018 von höchstens 1 Million Passagieren beschränkt.

1 INTRODUCTION

State aid measures can correct market failures and can help obtain more desirable and equitable market outcomes. However, regulation of State aid in the European Union ("EU") is of paramount importance to avoid negative effects of State aid on competition and distortions of trade between Member States, which is contrary to the common interest. The European Commission ("Commission") has awarded to the consortium, led for this project by Lear and also including DIW Berlin and Sheppard Mullin (the "Team"), a specific contract to carry out a study (the "Study") to support its evaluation of the Guidelines on State aid to airports and airlines, adopted with the Communication of the Commission 2014/C 99/03 ("Aviation Guidelines"). In particular, the Study has the objective to assess whether the existing rules under which Member States can grant operating aid to airports, are relevant and fit to their purpose of supporting the contribution of regional airports to local development and accessibility of certain regions, while at the same time limiting the distortion of competition.[7] The Aviation Guidelines, in section 5.1.2, outline the conditions under which the Commission considers that State aid in the form of operating aid to airports is compatible with the internal market pursuant to Article 107(3)(c) of the Treaty on the Functioning of the European Union ("TFEU"). The Aviation Guidelines consider that airports should normally be able to bear their operating costs. Operating aid is in principle considered a very distortive form of aid and can only be authorised in exceptional circumstances. Before the adoption of the Aviation Guidelines in 2014, many regional airports, often publicly owned, were receiving public subsidies to cover operating costs. In light of the contribution of regional airports to local connectivity and economic development in the European Union ("EU") and to allow airports to adapt to new market realities, the Aviation Guidelines designed a set of rules to prompt a gradual transition of regional airports to a competitive market, based on two pillars:

- during a ten-year (transitional) period, from 2014 to 2024, regional airports can still receive operating aid by public authorities, but, as of 2024, all airports are expected to cover their operating costs;
- the provisions link the intensity of operating aid that airports can receive during the transitional period to their traffic level, a relevant indicator of airports' financial situation.[8]

The Aviation Guidelines establish that the Commission shall evaluate the provisions by April 2020 at the latest. The Study is meant to provide support to the Commission's evaluation, through an independent evidence-based assessment, on three key questions:

- whether the ten-year transitional period ending in 2024 for the phasing out of operating aid to airports, is adequate for airports to reach coverage of operating costs;
- whether the thresholds that determine the access to and the intensity of operating aid are appropriate;
- the contribution of regional airports to local development, especially employment.

[7] In this context, "*regional* airport means an airport with annual passenger traffic volume of up to 3 million". See Aviation Guidelines, point 25(26).
[8] Based on data and on industry consensus, the lower the airport's traffic is, the greater the airport's financing needs are.

To accomplish the assignment, the Team has carried out five different tasks:

- the selection of a representative sample of airports across the EU (task 1, presented in section 4);
- the collection of data to perform the assignment, through a survey of selected airports and through publicly available sources (task 2, presented in section 4 and in section 5);
- the assessment of the airports' prospects of achieving the full coverage of their own operating costs by the end of the transitional period (task 3, presented in section 6);
- the assessment of the adequacy of the airport's categorisation based on airport traffic to regulate access to and intensity of State aid (task 4, presented in section 7);
- a review of the literature on the impact of regional airports on local development (task 5, presented in section 3).

2 THE AVIATION GUIDELINES

Under the EU rules on State Aid, operating aid may constitute, in principle, a very distortive form of aid and airports should normally bear their own operating costs. Nevertheless, the developments in the aviation industry and its expansion since the liberalisation of air transport in 1997– including the emergence and growth of low-cost carriers ("LCCs"), explain the fact that operating aid by public authorities to regional airports was widely used prior to the adoption of the Aviation Guidelines. Regional airports, defined in the Aviation Guidelines as airports with annual passenger traffic volume of up to 3 million, can indeed prove important both for local development and for the accessibility of certain regions, in particular against the backdrop of positive traffic forecasts for air transport in the Union.

To enable a gradual transition towards a competitive market, the Aviation Guidelines recognise that for a transitional period of 10 years starting on April 2014 "(…) certain categories of operating aid to airports might still be justified under certain conditions".[9] Accordingly, by the end of 2024 "*all airports must have reached full coverage of their operating costs and no operating aid to airports will be considered compatible with the internal market after that date, with the exception of operating aid granted in accordance with horizontal State aid rules, such as rules applicable to the financing of Services of General Economic Interest (SGEI)*".[10]

Moreover, the Aviation Guidelines define eligibility to and the intensity of operating aid during the transitional period based on airports' level of passenger traffic. The reliance on passenger traffic to identify financing needs is motivated by existing evidence on the relationship between an airport's financial situation and traffic levels, with financing needs normally being proportionately greater for smaller airports due to high fixed costs. The following categorisation of airports based on traffic levels is deemed as relevant to capture the need for operating support by public authorities:[11]

- airports with up to 200,000 passengers per annum may not be able to cover their operating costs to a large extent;
- airports with annual passenger traffic between 200,000 and 700,000 passengers may not be able to cover their operating costs to a substantial extent;

[9] In order to be compatible with the internal market pursuant to Article 107(3)(c) of the Treaty, State aid measures in general must be designed in a way such that the following cumulative conditions are met: i) contribution to a well-defined objective of common interest; ii) need for State intervention; iii) appropriateness of State aid as a policy instrument; iv) existence of incentive effect; v) proportionality of the aid amount; vi) avoidance of undue negative effects on competition and trade.
[10] Aviation Guidelines, point 129. Operating aid granted to airports within the scope of compensations for the provision and discharge of SGEI is subject to the Commission Communication on the application of the EU State aid rules to compensation granted for the provision of SGEI (2012/C 8/02), to the Communication on the EU framework for State aid in the form of public service compensation (2011) (2012/C 8/03) ("SGEI framework") and to the Commission Decision 2012/21/EU. The latter provides that State aid in the form of public service compensation granted to airports entrusted as SGEI where the average annual traffic does not exceed 200,000 passengers over the duration of the SGEI entrustment shall be compatible with the internal market and shall be exempt from the notification requirement of Article 108(3) of the Treaty.
[11] Aviation Guidelines point 118.

- airports with annual passenger traffic of 700,000 to 1 million should in general be able to cover their operating costs to a greater extent;
- airports with annual passenger traffic of 1 to 3 million should, on average, be able to cover the majority of their operating costs;
- airports with annual passenger traffic above 3 million are usually profitable at operating level and should be able to cover their operating costs.

In any event, therefore, airports with an annual passenger traffic exceeding 3 million passengers are not eligible for operating aid.

Given its distortive potential, and to provide proper incentives for efficient management of an airport, the operating aid amount must be limited to the minimum necessary for the aided activity to take place (proportionality of the aid amount), according to a set of rules that circumscribe it.

First, the aid amount has to be established *ex ante* as a fixed sum covering the *operating funding gap* ("OFG")[12] expected by an airport on the basis of an ex ante business plan that do not go beyond the transitional period.[13]

Second, operating aid cannot in any event exceed a maximum amount, which is a function of the *initial* OFG of the airport and of annual passenger traffic at the airport, where: the *initial* OFG is the average OFG reported during the five years preceding the beginning of the transitional period (2009 to 2013). The Aviation Guidelines define the maximum permissible aid amount in each of the 10 years of the transitional period as follows:

- 80% of the average initial OFG for airports with annual passenger traffic of up to 700 thousand; [14]
- 50% of the initial OFG for all other airports.

Last, a recent extension to airports and ports of the General Block Exemption Regulation ("GBER") has modified operating aid rules that apply to airports with annual passenger traffic below 200,000. Article 56 (a) GBER states that operating aid to airports with annual passenger traffic below 200,000 "does not give rise to undue distortion of trade and competition, provided certain conditions are met. The compatibility conditions should, in particular, ensure that the aid amount does not exceed the operating losses and a reasonable profit and that there is open and non-discriminatory access to the infrastructure. In addition, the aid cannot be made conditional upon

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[12] The OFG is equivalent to airports' operating losses after deducting all public resources received to cover operating costs. A more formal and analytical definition of the OFG is provided in section 6.1.1. Only a negative OFG over the transitional period is eligible for operating aid.

[13] No ex-post increase of the aid should be considered compatible with the internal market. Member State may pay the ex-ante fixed amount as an up-front lump sum or in instalments, for instance on an annual basis.

[14] The rules for airports with up to 700 thousand passengers per annum had been established initially for a period of five years but have more recently been prolonged until 2024 (i.e. the same 10-year transitional period now applies also to these airports). See "Communication from the Commission concerning the prolongation of the specific regime for operating aid for airports with up to 700 000 passengers per annum provided for in the Guidelines on State aid to airports and airlines", OJ C 456, 18.12.2018, p.27.

the conclusion of arrangements with one or more airlines relating to airport charges, marketing payments or other financial aspects of the airline's operations at that airport".[15] If the rules under the GBER are complied with, the aid measure does not need to be notified to the Commission, and an airport can receive State aid up to 100% of its operating losses, both during and beyond the transitional period. If the rules are not complied with, the measure is assessed under the Aviation Guidelines.

[15] Commission Regulation (EU) 2017/1084, point (5).

3 LITERATURE REVIEW OF THE IMPACT OF AIRPORTS ON REGIONAL DEVELOPMENT

3.1 OBJECTIVES OF THE LITERATURE REVIEW

The assessment of the impact of State aid on small and regional airports requires understanding the economics of these airports and the influence these airports have on their regional economies. To this end, the Team has carried out a review of the existing literature, reports and studies aimed at investigating: (i) the economics of small airports, including challenges to economic efficiency and profitability drivers in the short- and long-run, the effect of/on competition and complementarity with other airports and other modes of transport, the relationship with LCCs; (ii) the impacts of airports on regional development and employment in particular; (iii) cost-benefits analyses or any other evidence of the benefits of subsidising loss making airports, taking into account long term profitability opportunities of these airports and spill overs generated at the regional and country level (including those related to infrastructure competition or to alternative infrastructure development). Given the scope of the Study, the literature review gives emphasis to small and regional European airports.

The literature review has also corroborated and informed the empirical analysis on the adequacy of the transitional period and the airports categorisation as per the Aviation Guidelines. The review has indeed helped to identify the most appropriate indicators of airports' performance and the drivers of airports' profitability. Annex A lays out a summary table of key studies focusing on regional European geographies, highlighting for each paper and study cited the outcome variables analysed and the methodological approach.

The vast majority of the studies covered in this review have been published post-2000, yet, some older papers have also been covered. While the European aviation industry landscape has changed quite a lot over the last dozen years or so; we believe older studies also have their merit. Second, any time threshold that would allow one to focus only on more recent studies would be necessarily arbitrary. One should keep in mind that the fundamental laws of economics that govern the airports', the airlines' and the passengers' incentives have not really changed recently.

The review is organised as follows:

- in section 3.2, the key components that are thought to affect the long-term viability and sustainability of regional airports are presented: airport size, airport ownership structure, airport proximity/location, competition and cooperation with other infrastructures, types of incentives utilised, regulation and the proliferation of LCCs with its newly emerging trends that are likely to affect the industry going forward; seasonality and financial recessions;
- in section 3.3, empirical evidence on whether small and regional airports are associated with benefits to regional development is discussed. Indeed, however, the direction of causality is difficult to determine: is a regional airport thriving because the region's economy is thriving, or, does a thriving regional airport cause the region's economy to grow? We discuss several empirical studies that tackle this issue using various techniques and provide estimates for the impact of airports on the regional economies in which they are located;

- finally, in section 3.4, the benefits and costs of providing state aid in existing cases are outlined.

3.2 ECONOMICS OF SMALL AND REGIONAL AIRPORTS

While there is no conventionally accepted definition of the term "small airport", basic knowledge of airport economics can help us understand why *being small* is relevant in the industry. Being an infrastructure industry, airports are characterised by a high share of fixed costs. This in turn implies that economies of scale will play a role, and airports, even when they are run as efficiently as possible, will require to generate a certain minimum traffic level to break even. Small airports are in a catch-22 situation: being small, they are more expensive to run in terms of costs per unit of output, while being more expensive to run can make it difficult to attract more traffic – hence, they remain small. The typically limited size and population of the catchment area does not help either. At the same time, even where the level of demand for its services is outside of the airport's control; increased productivity and efficiency can help an airport improve its financial position and ultimately its attractiveness to their customers.

What this minimum level to break even is, however, remains a key open question. Indeed, perhaps a more important question is *whether* such minimum breakeven traffic level can be defined, given various idiosyncrasies present in the airport sector.

Also, the breakeven level may vary depending on the purpose. As already mentioned, the Aviation Guidelines, when referring to operating aid, indicate that airports handling fewer than 700,000 passengers per year may not be able to cover their operating costs to a large or substantial extent, while airports up to 1 million and up to 3 million passenger should, respectively, be able to cover a greater share or the majority of their operating costs. Airports with above 3 million passengers a year are usually profitable and thus excluded from access to operating aid.

On the other hand, when referring to investment aid, the Aviation Guidelines indicate that airports handling less than 1 million passengers per annum typically struggle to cover their capital costs, while airports with traffic level up to 3 million passengers should be able to cover their capital costs to a greater extent; however, there is an acknowledgment that even if airports with traffic level between 3 and 5 million passengers per year should cover all their costs (including both their operating and capital costs), they may fail to do so and, in very exceptional circumstances, require public support to support some of their capital costs. Airports handling over 5 million passengers per annum should instead be able to reach profitability.

According to the Airports Council International[16] ("ACI") data, about 75 EU airports (out of 355 airports within the EU that are members of the Association) have exceeded 5 million passengers in 2018. (ACI Europe, 2016) also reports that over 40 % of European airports are loss making, further emphasising the importance of scale of operations in this industry.

This section reviews the available economics literature by focusing on factors that are thought to determine airports' economic performance. These factors are relevant to this Study for two main reasons: they can be correlated or cause performance and thus be relevant to determine the

[16] Airports Council International (ACI) is an association representing airports' interests in dealing with the regulators and airlines.

need or intensity of aid; and/or they may alter competition and thus be relevant to identify conditions to aid. One of the key relationships in the airport industry from the point of view of economics is that between the airport's size measured in terms of traffic, and its economic performance (see section 3.2.1). Proximity to other airports, ownership and management structure, networks, incentives to airlines and LCCs' developments, regulatory environment, as well as the choice between (or the coexistence of) different modes of transport, are all related to both airports' performance and competition concerns. The literature on these factors is reviewed in sections 3.2.1 to 3.2.8. Finally, section 3.2.9 presents the existing evidence on seasonality and fragility to economic recessions that may also impact performance and be relevant to consider the need of aid.

3.2.1 Airport size

The key issues studied in the economics literature are the relationships between airport traffic and efficiency on the one hand, and traffic and profitability on the other. Primarily due to the available data, the former is given much more attention in the literature than the latter. At the same time, the key question of the minimum scale for an airport to achieve profitability has not yet been clearly answered in the existing studies.

Small and regional airports frequently suffer from limited traffic given the comparatively few people and businesses located in their catchment area. They face low traffic demand relative to the minimum infrastructure necessary to produce safe and secure traffic movements. As a result, the costs incurred per movement are substantially higher than at their larger airport counterparts and should the prices be set such that they could cover the full costs of the facility, there would be few to no users. This has often been used as an argument to claim that financial aid to smaller airports seems inevitable in order to sustain existing levels of service, as it is almost impossible for these small airports to operate profitably without external support (Adler, N., Ulku, T., Yazhemsky, E., 2013). [17]

In line with the existing literature (Coto-Millán, P., Casares-Hontañón, P., Inglada, V., Agüeros, M., Pesquera, M.A. & Badiola, A., 2014), found that larger airports are expected to have higher overall technical and scale efficiencies than smaller ones.[18] The authors state that this effect cannot only be explained by the economies of scale in airport operations, but also because larger airports are more efficient than smaller airports under variable returns to scale after removing the effect of the scale of production. Other studies finding a similar link between airport size and efficiency include (Tsekeris, T., 2011); (See, K.F., & Li, F., 2015). (Pels, E., P. Nijkamp, & P. Rietveld , 2003), however, suggest that efficiency of airports of various sizes will be adversely affected by the inefficiency of airline operations (i.e., low passenger load factors).

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[17] Adler's study used 2002-2009 data from 85 airports located in 7 European countries. Annual passengers served at each airport ranged from 3000 to 1.6 million. Inputs were staff costs, operating costs, runway length. Outputs were number of passengers, commercial air traffic movements ("ATM"), cargo, non-aeronautical revenue. Managerial efficiency focused on runways, ATM, passengers, and cargo as non-discretionary variables over which airport managers have little to no influence. See Summary Table in the Appendix for further details.

[18] (Coto-Millan, P., Casares-Hontanon, P., Inglada, V. & Agueros, M. , 2014.)'s study used 2007-2009 data from 35 Spanish airports.

Smaller airports are also disproportionately affected by high fuel prices because these prices make it harder to profitably operate smaller regional jets. (Wittman, 2014) studied the effect of this in 2008 when U.S. airlines began to restrict domestic capacity at smaller airports as a result of rising fuel prices and the financial recession. He found that smaller airports and/or the local communities serviced by them responded by providing financial incentives directly to airlines in exchange for continued services. These incentive packages, however, were expensive and almost always required contributions from private area businesses or the government.

As we noted above, the link between airport size and profitability is under-explored. Yet, the literature offers a few studies in this area. In a study of European and non-European national and regional airports, (Zuidberg, J. , 2017) found that an increase in the number of passengers does not influence profit margin, but is likely to lead to higher absolute profits, as the revenue increases with the profit margin remaining unchanged.

(Abbruzzo, A., V. Fasone, & R. Scuderi , 2016) offer an analysis of profitability of Italian airports, demonstrating that to increase profitability the airports need to attract larger aircraft. Interestingly, one implication of this result for the regional airports (at least in Europe and North America) appears to be that those airports should aim to attract the low-cost carriers rather than network airlines, other things equal. The LCCs tend to enter those airports with larger sized aircraft as opposed to the legacy network carriers. European and North American LCC fleet usually includes regular narrow-body aircraft (such as Boeing-737 or Airbus-320 planes); whereas network carriers often serve regional airports through their subsidiaries or contractors operating a fleet of lower capacity regional jets.

In Poland, (Huderek-Glapska, S. & Nowak, H. , 2016) studied regional airports over a two-month period in 2015. They found that despite increasing air traffic overall from November to December due to holiday travels, only the five airports in their sample serving more than 2 million passengers were profitable; within this small group, net profit was made at the four largest airports (Wroclaw being the only non-profitable airport in the country handling over two million passengers per annum). They also found that the greatest losses were generated by small regional airports. The two main reasons for this were that high fixed costs resulted from new infrastructure investments and there was not enough increase in traffic figures.

One can ask the question of the extent to which the traffic level at an airport is exogenously determined. Even though final demand for transportation is derived from demand for other services, airport management and marketing efforts could in principle affect the volume of traffic it ends up handling. On the other hand, airports could in principle restrict the volume of traffic they handle by exercising the market power some of them possess (Bilotkach, V., & A. Polk, 2013). This question of the potential traffic level an airport could handle is however not covered in the literature. Instead, available studies take airport size as given, and evaluate the relationship between the traffic volume and efficiency/productivity.

3.2.2 Proximity to other airports

Competition between airports is increasingly acknowledged as an important phenomenon in this sector (Thelle, M.H., & M. la Cour Sonne , 2018). While exact nature and driving forces of this competition may require further analysis to be understood, overlapping catchment areas is generally believed to be a factor yielding competition between the affected airports for origin-and-destination passengers residing in (or traveling to) the respective urban area. A competitive environment is generally conducive to increased efficiency, absent collusive arrangements between the key players.[19]

(Tapiador, F., Mateos, A. & Martí-Henneberg, J., 2008) defined “geographical efficiency” as a measure of how efficiently an airport benefits from its location. This measure is defined as the ratio between the location assets of the airport and traffic generated.[20] The authors suggest that not only are individual management strategies more efficient (see section 3.2.3), but also that competition between neighbouring airports may encourage development. (Tapiador, F., Mateos, A. & Martí-Henneberg, J., 2008)’s study contained data from all mainland airports in Spain in 2006.[21]

(Adler & Liebert, 2014) studied 48 European airports and 3 Australian airports from 1998 through 2007. They concluded that competition leads to cost efficiency, regardless of ownership type. At the same time, private airports tend to charge higher aeronautical prices, based on the finding that, in their sample, unregulated, fully private airports located in a competitive setting can charge higher aeronautical fees than unregulated public airports. Combining the results from their efficiency and revenue models reveals that imperfect competition is sufficient to encourage airport cost efficiency and reduce the likelihood of abuse of market power. For non-hub airports with weak local competition, they find that more economic regulation is required in order to encourage cost efficiency, although not all regulatory models are equally conducive to cost efficiency.

The two studies of determinants of aeronautical charges we mentioned above also touch upon the issue of overlapping catchment areas. (Bel, G. & X. Fageda , 2010) do find that presence of other airports in the vicinity decreases the aeronautical charges. (Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang, 2012) however, find no statistically significant relationship between the two variables. The latter results could be explained by little identifying variation in the variable of interest in the panel data setting. More recently, (Bottasso, A., M. Bruno, M. Conti, & C. Piga , 2017) found a link between airport competition and aeronautical charges in the UK setting over the period 1996-2008. The authors find that “stronger airlines' bargaining power, more intense competition in each airport catchment area and higher degrees of route substitutability are associated to lower airport charges” and that “variations in route substitutability affect aeronautical charges only when the upstream airport market is sufficiently competitive, which in turn suggests a form of complementarity between competition in the airport (upstream) and airlines (downstream) markets”.[22]

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[19] We should note however that some researchers are sceptical about the very concept of airport competition, asserting that airports tend to have enough captive customers to exert market power. See, for instance, (Wiltshire, J. , 2018).

[20] Location assets refer to key benefits an airport obtains from its catchment area such as population, level of economic activity, tourism potential, and accessibility.

[21] The largest airport, Madrid, served 45.5 million passengers and the smallest airport, Albacete, served 17,500. 25 of the 42 airports served less than 2 million passengers in 2006.

[22] The paper adopts a standard approach to identify an airport catchment area (a circle of 90 kilometres around each airport), and build structural measures of competition in the upstream airport market (as

On the other hand, (Heymann, E. & Karollus, A., 2015) are of the opinion that if two or more regional airports are located close to one another, their catchment areas will overlap, and they will target the same customers which would trigger cutthroat competition and/or cannibalisation effects. This issue can be especially relevant where the airports with overlapping catchment areas are located in different federal lands, a barrier to coordination in airport capacity management. The paper is a report by Deutsche Bank that focuses on German airports that serviced between 200,000 to 3 million passengers per year.

Along the same line of evidence of negative effects of airports' proximity on airports' performance, (Ülkü, 2014) finds that distributing total demand across airports in one region is less favourable than concentrating demand at one key airport.[23] Having a close competitor decreases the volume of total output at each airport and therefore drives up operating costs per movement.[24] In fact, economies of scale are working in the opposite direction as competition here. The statement of the study is that, if we compare the cases of one versus competing airports, for the otherwise equal traffic total traffic volume, the traffic at an individual airport will be lower if there is a competing airport nearby. Hence, the cost per passenger will be higher, keeping the total traffic volume across all the airports constant.

Concluding, the literature generally demonstrates a positive effect of competition between the airports. Airports that have to compete tend to be more efficient and charge less to their customers, other things equal. We should however be mindful of the possibility that where the airports compete for a limited volume of traffic, they will end up sharing the passengers/movements in a way that could result in a higher per passenger cost as compared to the case where the traffic would be handled by one airport.

3.2.3 Ownership structure

Airports have also witnessed the general tendency towards bringing the private sector into the infrastructure industries. Accordingly, a number of airports around the world have been fully or partially privatised (see (Gillen, 2011), for a critical discussion of the developments in this area). Thus, the issue of the relationship between the ownership structure and airport performance indicators emerges. In theory, private owners are considered to be more efficient caretakers of the assets as compared to the case where an airport is publicly owned. Private owners are expected to deliver profitability and will accordingly take action to maximise revenue and/or minimise costs (the latter will be the main focus where, for instance, an airport is price regulated, limiting the manager's ability to exert additional revenue through higher prices). Public

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airports in overlapping catchment areas offer services to the same destinations) and of competition in the downstream airline market (airlines countervailing power and the degree of route substitutability within airport; the latter is a proxy for the inverse of airline product differentiation, where high differentiation signals greater market power of airlines). (online version available at http://www.sietitalia.org/siet2015/paper/Bottasso_Bruno_Conti_Piga.pdf, accessed 18 October 2019, p. 3).

[23] (Ülkü, 2014) looks at a panel dataset of 41 Norwegian airports between 2002 and 2010 and a panel dataset of 26 French airports between 2002 and 2009, both dominated by small, regional airports. Examples of Norwegian airports include Røst, Sørkjosen, Alesund, Bardufloss, Narvik, Alta, Vadsø, Mehamn, Hasvik, Florø, etc. Examples of French airports include Beauvais, Lorient, La Rochelle, Biarritz, Perpignan, Calvi, Caen, Nimes, and Ajaccio.

[24] Total output is calculated by dividing the total operational costs by the annual number of passengers served. Total operational costs include labour, materials, and outsourcing costs; it excludes depreciation.

enterprises are, in theory, expected to maximise social welfare – a concept not amenable to easy quantification (Viscusi, W.K., J.M. Vernon, & J.E. Harrington, 2005). As a consequence, public enterprises (including publicly owned airports) could overemphasise quantifiable perceived correlates of social welfare, including, for instance, quality of service. Such emphasis could lead to overinvestment into quality, which may be manifested in the data as reduced efficiency.

A number of studies in the literature attempt to shed some light on the relationship between airport ownership structure and airport efficiency. The literature does not allow a definitive conclusion on this issue, but some arguments can be found that speak in favour of either private or public ownership of airports. The key studies addressing this issue are reviewed below.

- Perhaps the most well-cited study making a case for increased efficiency due to privatisation is (Oum, T. H., Yan, J. & Yu, C. , 2008). This work covers 109 airports around the world in a panel setting. Airports in the sample vary in terms of size, ownership and institutional arrangements. The key findings of the study are as follows. First, airports owned by private firms, autonomous public corporations or independent authorities are more cost efficient than fully government-owned airports.[25] At the same time, partially privatised airports are less efficient than either fully public or fully private ones. Both wholly owned private airports and wholly owned government airports have a more favourable ownership structure than a mix of private/public ownership. The authors suggest that "private-public partnership with minority private sector participation and multi-level governments' ownership should be avoided”. The second key finding of (Oum, T. H., Yan, J. & Yu, C. , 2008) is that privatization of one or more airports in cities with multiple airports improves the cost efficiency of *all* airports in that city. Finally, they find that ownership structures in which management can exercise a larger degree of autonomy improves cost efficiencies at airports, regardless of the owner’s identity.
- In addition to Oum et al. study, (Graham, A. , 2009), (Pels, E., P. Nijkamp, & P. Rietveld , 2003), (Tsui, W.H.K., A. Gilbey, & H.O. Balli , 2014) and (Chen, Y-H., P-L. Lai, & P. Piboonrungroj , 2017) point out that privatized airports perform, in general, better than state owned ones in terms of efficiency and competitiveness.
- While in theory, private ownership should be associated with higher efficiency; this link may fail to materialise. Rent-seeking behaviour by the owners, regulatory capture (in case privatised airports are also subject to economic regulation), and poor corporate governance exacerbating the principal-agent problem[26] in case of separation of ownership and management responsibilities are some of the factors which could lead to such an outcome.

In a study of 33 Italian airports from 2005-2008, (Martini, G., Manello, A. & Scotti, D. , 2012) found that the higher the stake of public local authorities in the airports’ ownership structure, the higher

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[25] The authors use Stochastic Frontier Analysis (“SFA”), estimating the trans-log cost function (using total – including both capital and operating - cost). The SFA methodology uses deviations from the estimated cost frontier to measure cost inefficiency.
[26] Principal-agent problem in corporate governance and economics relates to the agent (e.g., a CEO) acting in its own interests, which may not align with the interests of the principal (i.e., owners).

their technical/environmental efficiency. This could be explained by the fact that local authorities may be more sensitive to problems related to noise and local air pollution, since they affect their voters. This may be an argument mitigating the expected benefits from privatisation of airports when accounting for externalities. Likewise, (Parker, D. , 1999) found no improvement in airport performance when UK airports where privatised in July 1987.[27]

Another strand of the literature studying the link between airport ownership and performance has focused on the relationship between the ownership and aeronautical charges. At this time, there are only two studies that tried to answer this research question[28], but we expect more work to appear in this direction in the near future as the evidence is mixed. (Bel, G. & X. Fageda , 2010) examined the issue in cross-sectional context, using data for 100 European airports. They conclude that privatised airports' charges are higher than those set by publicly owned airports, controlling for usual airport characteristics. (Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang, 2012) use a panel data approach on a sample of 61 European airports over 18 years (including 40 of the airports also covered by (Bel, G. & X. Fageda , 2010) study). The conclusion reached by Bilotkach et al. is opposite to the findings of (Bel, G. & X. Fageda , 2010). Namely (Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang, 2012) find a negative relationship between the share of private ownership and average aeronautical charges, and for their sample they conclude that a ten percent increase in private ownership share saves all airlines serving an average partly or fully privatised airport upwards of €1.65 million per year in year 2000 prices. We should note that the two studies use different methodologies (cross-sectional sample in (Bel, G. & X. Fageda , 2010) and panel data (Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang, 2012)), and different measures of aeronautical charges. While (Bel, G. & X. Fageda , 2010) estimated the charge for landing an A-320 at each airport in their sample, (Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang, 2012) divided aeronautical revenue by the number of aircraft movements to arrive at their measure of aeronautical charge. The substantial differences in the methodological approaches and data do now allow so far to draw more support for one or the other conclusion.

Last but not least, we should mention a potentially important issue, which has so far eluded scholars' attention – most likely due to the lack of data required to shed light on it in any meaningful way. We can expect that private sector might be more attracted to the airports, which offer higher profit potential. If this is true, positive link between privatisation and efficiency found in some papers cited above might not necessarily be causal. In the worst case – with more efficient airports cherry-picked for privatisation over the less efficient ones – the causality reported in the literature might be non-existent. We however do not at this time have enough information to draw any meaningful conclusions on this matter and can only acknowledge that the issue does exist.

[27] Airport performance was measured in terms of technical efficiency, using turnover, passenger, cargo, and mail volumes as outputs. Inputs included number of employees, capital inputs, and other inputs (defined as residual of total operating costs).

[28] Another study of note here is (Van Dender, K. , 2007), examining the determinants of aeronautical charges at US airports. This paper, however, is not relevant for the present discussion, as all airports in the United States are operated as public enterprises, which does not allow the author to draw conclusions on the relationship between airport ownership and its performance.

3.2.4 Cross-subsidisation and airports operating within a network

A closely related issue to ownership is regarding airport network systems and cross-subsidisation within the network. Airport management through networks may alter competition (both for final demand for transportation and for airlines' services). Many airports in Europe are operated within a network and not managed as a standalone entity. In fact, all airports in Norway, Sweden, Finland, and Spain are managed by a single network operator. Moreover, the single network operator is often a public entity: e.g., in Poland and Norway, all airports are owned or operated by government entities; in Spain one state-owned company runs most of the airports in the country; the Highland and Islands Airports Limited (HIAL) is a public enterprise that manages small-sized airports in Scotland.

Notably, most available studies of airport networks focus on managerial efficiency rather than profitability of individual airports within the networks. This can be generally explained by the data availability – airport system operators usually report financial data for the entire system, while input and output numbers tend to be more readily available at individual airport level.

According to (Adler, N., Ulku, T., Yazhemsky, E., 2013), airports within a network are generally not subject to competition and rely on joint operational planning with a need for direct or indirect subsidies for ongoing operations. For instance, all Norwegian airports are owned by the same government corporation, with the four largest airports in the country subsidising the remaining 42 airports. In France, airports are subject to individual ownership and operation, but the airports incurring financial losses require financial aid provided by The Directorate General of Civil Aviation.[29]

Based on a 2002-2009 study of 85 small European airports, (Adler, N., Ulku, T., Yazhemsky, E., 2013) concluded that operating within a system (*i.e.,* in Spain where most airports operate within a single, public framework) appears to have a significantly negative effect on managerial efficiency in comparison to standalone airports. Managerial efficiency was scored in units of staff and operating costs and runway length per number of passengers served, commercial air traffic movements, tons of cargo, and non-aeronautical revenues (Adler, N., Ulku, T., Yazhemsky, E., 2013) found that standalone European airports achieved, on average, five percent higher efficiency scores than their counterparts operating within a system. One explanation the authors put forward is that standalone airports are more focused and unencumbered by a head office. Likewise, (Tapiador, F., Mateos, A. & Martí-Henneberg, J., 2008) observed that standalone management of regional airports leads to better incentives and could unleash latent potential in many of Spain's regional airports, particularly those serving coastal, tourism-based areas.

On the other hand, (Bel, G. & Fageda, X, 2009) found evidence from the publicly owned network in Spain to be inconclusive. They noted that cross-subsidisation may foster inefficiencies in smaller regional airports but can also help avoid cannibalisation. Management of the system often reflects regional, political motivations rather than economic efficiencies.

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[29] With respect to these two examples, the average government subsidy is €26/passenger in Norway and €3/passenger in France (Ülkü, 2014).

Another interesting case that can help us understand the functioning and impact of airport systems, is the break-up of the British Airport Authority ("BAA"), ordered by the UK Competition Commission in 2009. [30] (Littlechild, S. , 2018) describes the evolution of airport competition and regulation in the UK. Under the terms of that order, the BAA was required to sell one of London area airports (either Heathrow or Gatwick); and divest itself off either Glasgow or Edinburgh.

UK Competition and Market Authority ("CMA") released a report in 2016 outlining the benefits of BAA break-up[31]. In addition to increased passenger numbers at all the airports sold by BAA, the report noted benefits in terms of improved service quality and efficiency; increased investment in facilities; development of positive long-term relationships with airlines over issues like airport charges; route development; and innovations to maximise limited runway capacity. Cumulative benefits from the decision to break up BAA were estimated to total up to £870 by 2020. In a recent study, (Pagliari, R., & A. Graham , 2019) found that aeronautical charges at Glasgow and Edinburgh have diverged since separation, increasing in the former airport, and falling in the latter. Glasgow and Edinburgh were both owned by the BAA, but the company had to sell one of the two, and it sold Edinburgh in 2012. Glasgow was sold later in 2014.

Overall, the consensus that appears to arise from the papers reviewed in this section echoes one of the conclusions of (Oum, T. H., Yan, J. & Yu, C. , 2008) study we reviewed in some detail before. Managerial autonomy appears to be an important factor driving airport efficiency, and when airports are operated as a system, individual airport managers may see their decision-making authority hampered, leading to sub-optimal outcomes. As all the airport networks around the world are publicly owned, we cannot draw clear conclusions regarding the relationship between ownership type and efficiency for such networks. [32]

3.2.5 Airport incentive programs

As discussed above, size is one of the most important determinants of airport profitability. It is therefore crucial for airports to increase traffic and attract new airline carriers and new routes to their hub. Incentive programs are a way to achieve this. In this section we discuss their prevalence in Europe and conditions for their viability.

Among European airports, more than 60% offer some form of an incentive scheme. Smaller airports are more likely to have bilateral agreements (either airport-airline or regional authority-

[30] "In 2006 BAA was acquired by Airport Development and Investment Ltd (ADI), a wholly owned subsidiary of FGP Topco Ltd, in which, as of 6 June 2008, Grupo Ferrovial, SA held 55.87 per cent of the ordinary shares. The other two shareholders in FGP Topco Ltd are Britannia Airport Partners LP (26.47 per cent), which is managed by Caisse de dépôt et placement du Québec, and Baker Street Investment Pte Ltd (17.65 per cent), a subsidiary of GIC Special Investments Pte Ltd" (https://webarchive.nationalarchives.gov.uk/20140402170348/http://www.competition-commission.org.uk/assets/competitioncommission/docs/pdf/non-inquiry/press_rel/2009/mar/pdf/11-09.pdf, accessed on September 4, 2019).

[31] https://www.gov.uk/government/news/cma-report-shows-benefits-of-baa-break-up (accessed on September 10, 2019).

[32] We can consider BAA before it sold off its airports and reinvented itself as Heathrow Airport Holdings to have been a privately-owned airport network (see footnote 30); however, we are not aware of any studies in the literature focusing on differences between BAA and publicly owned airport networks.

airline) while larger ones more often have general, official incentive schemes (Malina, R., Albers, S. & Kroll, N. , 2012).

Incentive programmes can take various forms as described by (Wittman, 2014):

- revenue guarantees: for example, if a regional airport makes a €500,000 revenue guarantee to an airline, and the local route only realises €200,000 in revenue over a certain time period, the airport will pay the airline €300,000 to cover the difference;
- waived or reduced use fees: for example, waiving or reducing departure charges, parking, and other airport rents;
- advertising and marketing assistance: many small airports are located in multi-airport regions in which passengers will drive long distances to nearby airports to save on price. Airports can either contribute to a carrier's advertising budget for marketing a new service, provide free or reduced-price in-airport advertising space, or directly purchase advertisements to attempt to attract passengers to use a newly introduced service;
- travel banks: airports are responsible for selling a certain number of prepaid travel vouchers – there is limited evidence of success for these programs based on previous studies;
- direct subsidies: these are payments that go to the airlines directly.

(Malina, R., Albers, S. & Kroll, N. , 2012) found that among the airports that offer incentive programmes, 78% reduce airport charges, while promotional payments are granted by 46% of airports (of which 52% is earmarked to partly fund specific airlines' marketing campaigns). In their study of the detailed pricing structures of 23 German airports, the authors found that incentive programs at all airports substantially reduce the level of charges and that the reduction lies above a 10% for all but one airport. The duration of the incentive programs was typically between 2 to 5 years.

As mentioned in section 3.2.1 however, such incentive programs can be quite costly, especially for small airports who have generally low bargaining power with carriers, as evidenced by (Laurino, A. & Beria, P., 2014). In their paper, they focused on the Italian airport system, including three case studies regarding Aeroporti di Puglia, Alghero and Emilia-Romagna airports. They observed that the low bargaining power of small airports can be attributed to:

- the reliance of small airports on a single dominant carrier;
- strong cannibalisation between airports willing to attract LCCs specifically. Routes may therefore be switched as soon as the incentives ends;
- lack of negotiating experience by small airports, and information asymmetry between the airports and the LCCs (note that the issue of LCCs will be discussed in greater detail in the 3.2.6).

In the long run, incentive programs can be profitable if carriers continue to offer the same service even after the discounts have ended. This could be because they reduce the risk of the carrier opening a new route elsewhere and because the carrier makes airport-specific investments and would have high switching costs later (Malina, R., Albers, S. & Kroll, N. , 2012).

Ultimately, prices lower than marginal costs could also be profitable to the airport because it operates as a platform. As such, it generates revenues both from the airlines and the passengers through non-aviation revenue streams such as the shops operated at the airport. Losses incurred in the airline-airport market could thus potentially be offset by increased profits associated with selling ancillary products or services (*i.e.*, at airport shops and restaurants), as discussed by (Malina, R., Albers, S. & Kroll, N. , 2012) in their study of 200 airports in Europe.[33]

Overall, however, there is no conclusive empirical evidence suggesting that incentive programs in general make good business sense and increase sustainable profits in the long run. (Fu, X., W. Homsombat, & T.H. Oum , 2011) suggest that welfare implications of airport-airline relationships are complicated, and find cases where incentives increase hub position of the key airline(s). Where incentives are targeted at specific carriers, these airlines can enjoy enhanced market power. In a review of German experience with airport incentives, (Fichert, F., & R. Klophaus, 2011) find no clear pattern, suggesting that effects are airport specific.

3.2.6 Impact of Low-Cost Carriers (LCCs)

There is no universally accepted definition of the term “low cost carrier”. Academic studies did not produce a clear cost threshold to separate the LCCs from other carriers; and the airlines commonly assigned to this group follow different business models around the world. Generally speaking, in the European context the airlines assigned to this group tend to focus predominantly if not exclusively on point-to-point services; practice significant unbundling of their product; and aggressively pursue cost reduction strategies in dealing with labour, suppliers, and airports. Some of the LCC airlines in Europe (most notably, Ryanair and Wizzair) tend to serve a number of destinations in their network via secondary remote airports, leveraging their countervailing power to reduce – sometimes to the point of elimination – their cost of using the airport infrastructure.

As a result, many regional and secondary airports are closely linked to the LCC. This can affect the financial well-being of airports. (Choo, Y. Y. & Oum, T. H. , 2013) look at productivity in 63 US airports and conclude that a high share of LCC traffic does not per se influence productivity, as measured by their variable input index divided by their output index (the authors do not consider effects on operating profit levels, which could instead be affected).[34] They do however, find that the mixing of substantial full-service carriers (“FSC”) and LCCs lowers productivity. This suggests significant returns to specialisation. Thus far, we have not observed a general LCCs effect on airport profitability: (Zuidberg, J. , 2017) finds that a growth in Ryanair and EasyJet traffic has no effect on Gatwick’s profit margin. This result however implies that if profit margin is positive – as

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[33] This is based on a study by (Malina, R., Albers, S. & Kroll, N. , 2012) taking into consideration the 200 biggest airports in the European Union based on total passenger numbers in 2009, excluding airports of French overseas counties. The biggest airport in the sample is London Heathrow (66.2 million passengers); the smallest is Clermont-Ferrand airport (400 thousand passengers). Although primary and secondary airports are included, the sample also contains data on more than 120 tertiary airports servicing less than 3 million passengers annually.

[34] Airports in the sample have on average 30% of passengers travelling on LCCs. Inputs consists of costs (e.g. buildings, runways, investments, other capital expenditures) and outputs consist of revenues (both aeronautical and non-aeronautical), aircraft movements, and passenger volume. Revenues are adjusted for cost of living in that location.

LCCs bring more traffic to the airport – airport profit levels are positively affected by the entry of low-cost carriers.

In Poland, (Huderek-Glapska, S. & Nowak, H. , 2016) survey 6 airports belonging to two groups of regional airports: (1) medium-sized airports serving 1 million to 4 million passengers a year; and (2) small airports serving less than 0.6 million passengers a year.[35] The authors noted the following:

- small airports are likely to be exposed to an imbalance of power and negotiating advantage in favour of the LCC in relation to the airport. They conclude this from survey results among regional airports asking specifically about bargaining power. One of the reasons for this situation, they note, is that at these airports the high share of low-cost passenger traffic ranges from 68% to 94%. This is in line with the interpretation of (Laurino, A. & Beria, P., 2014)'s study referenced in section 3.2.5;
- the most important factor for maintaining durable relations (and acquiring new ones) between airports and LCCs is to ensure the most favourable financial conditions for the airline. Airports are willing to utilise their revenue to retain and attract relations with LCCs.

(Huderek-Glapska, S. & Nowak, H. , 2016) also note that all except one of the airports they surveyed had over a decade-long relationship with LCCs and as such, the degree of cooperation between Polish regional airports and LCCs had reached "a certain maturity".[36] The benefits of such cooperation can be identified through increases in the number of passengers and in non-aeronautical revenues (there is limited evidence regarding increases in direct aeronautical revenues). Profitability can also be positively affected (if non-aeronautical revenues increases, direct aeronautical revenues do not decrease net of incentives to airlines and if operating costs do not increase); however, this point remains outside the scope of the study.

Whilst LCC traffic is often linked to small, regional, and secondary airports, this is not necessarily always the case. (Dziedzic, M. & Warnock-Smith, D., 2016) studied LCC trends in the UK, Spain, Italy, and Germany split across primary, secondary and regional airports in April 2015.[37] Their network analysis showed that LCCs are transitioning their focus to primary airports because they are increasingly interested in serving business passengers. For instance, the authors documented that 58% of LCCs capacity growth over the year preceding April 2015 happened in primary airports (versus 35% in secondary gateways). The authors also demonstrate several vivid examples of LCCs moving more of their capacity to primary airports over the 2008-2014 time period.[38] This evidence calls into question the future importance of smaller airports for LCCs. From the available literature, LCC presence is not guaranteed to increase profitability/efficiency of small airports,

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[35] Examples of medium-sized airports include Krakow, Wroclaw and Poznan. Examples of small airports include Rzeszow, Szczecin, and Zielona Gora.

[36] Primary data was collected by survey method using a specially designed research questionnaire and conducting direct, telephone or computer interviews with airport directors responsible for sales, marketing and/or strategy at 9 regional airports (only 6 responded).

[37] The LCCs chosen were Ryanair, easyJet, and Norwegian.

[38] For instance, in 2008, Ryanair was not present in the main Barcelona el Prat airport, serving the area via its bases in Girona and Reus; yet by 2014 the carrier served as many destinations from Barcelona as from the secondary airports in the area. Moreover, in 2014 Ryanair served 15 fewer destinations via secondary Barcelona airports than in 2008. Some figures from the paper are reported in Annex A.

despite bringing in more traffic. In the future, even higher traffic volumes are not guaranteed for the small airports.

3.2.7 Regulatory Environment

Many airports, especially larger ones, are subject to some form of economic regulation (or monitoring) of their aeronautical charges. The rationale for such a policy direction is the potential for abuse of market power, since many airports tend to be the only providers of the infrastructure required by the airlines and other aviation users in a certain area. Furthermore, the chosen regulatory regime can have an impact on airport efficiency, as some of the mechanisms employed by the regulator (as discussed below) are aimed at incentivising efficiency improvement.

Even in multi-airport regions, the regulators often recognise that some airports may enjoy a stronger competitive position, which could lead to them exerting market power. For instance, out of all the London area airports, only Heathrow and Gatwick are subject to direct price controls, while Stansted, Luton, City and Southend airports can set their aeronautical charges as they see fit. On the non-aeronautical side, airports are generally allowed to set market rates for their services (such as parking and terminal space rental), as the regulators believe there to be sufficient competition on those markets to discipline pricing by the airports[39].

(Forsyth, P., D.W. Gillen, A. Knorr, O.G. Mayer, H.-M. Niemeier, and D. Starkie, eds., 2004) provide a comprehensive – albeit somewhat dated – overview of the history and practice of worldwide airport regulation. The economic regulation of airports is typically determined and implemented by sectoral regulator (e.g., a Civil Aviation Authority), although cases of airport regulation falling within the purview of general competition policy are also encountered (e.g., the Netherlands). Some countries – most notably Australia and New Zealand – chose to stay away from directly regulating airport pricing, opting instead for monitoring with a threat of bringing the regulation back in case airports are found to be abusing their market power.

The basic rate-of-return regulation of aeronautical charges tends to deliver suboptimal outcomes than incentive regulation mechanisms, most notably the price cap. The key reason for this is that the rate-of-return regulation does not provide incentives for cost efficiency, instead incentivising the regulated companies to over-invest into capital (a phenomenon known as Averch-Johnson effect). Price cap limits allow increases in the regulated price by the inflation rate minus the expected efficiency gain. This means that inflation-adjusted revenue under the price cap is set to fall automatically (other things being equal); and the only way for the regulated company not to face reduced profit is to reduce its costs. It should be noted, however, that (Starkie, D. , 2004) suggests an equivalence between price-cap and cost-based regulation, with the former degenerating to the latter over time, if not applied correctly.

Another important determination an airport regulator has to make relates to incorporating airport's profit on the non-aeronautical side of its business into the regulatory framework. Two "pure type" regulatory frameworks exist with this respect. Under the single till formulation, airports' profits (all or some of it) are used to offset the aeronautical costs, with the airlines then being billed for the remainder of these costs. With the dual till, the airlines are billed for the entire

[39] Even where an airport is the only provider of parking services, passengers still can respond to higher parking charges by using an alternative mode of transport to a personal car.

aeronautical costs, without regard for the profit on non-aeronautical side. Naturally, the airlines prefer single till to dual till approach, as under the former they will be paying less for using airport facilities, other things equal.

We have over the years accumulated a body of theoretical work on the effect and welfare properties of different airport regulation policies. For example, (Czerny, 2006), (Yang, H. and A. Zhang , 2011) consider the optimal form of airport regulation. The focus of these studies is on describing optimal price cap regulation from a social welfare perspective;[40] the latter paper also incorporates airport congestion into analysis. (Czerny, 2006) shows that single-till regulation welfare dominates dual till setting in a non-congested airport. Yet, the airport does not have an incentive to implement welfare-maximising price-cap, as doing so would reduce its profitability. (Yang, H. and A. Zhang , 2011) demonstrate that dual till may produce higher welfare than single till regulation, when congestion is a serious problem (cost of congestion lowers social welfare, other things equal; dual till yields higher aeronautical charges, effectively acting as a congestion management tool; impact on airport profitability is ambiguous). (Brueckner J. , 2002) and (Basso, L. and A. Zhang , 2008) explore the airport-airline relationship concerning aeronautical charges in the peak/off-peak context. These studies are a part of the debate on airport congestion self-internalisation. The idea proposed here is that airline(s) with a dominant position at an airport will have an incentive to self-internalise the airport congestion externality, as the congestion impact is imposed in large part on the airlines themselves[41].

Results of those models have not yet been strictly speaking taken to data. Despite importance of the regulatory environment for airport performance as suggested by the theoretical literature, the relevant empirical literature is in its infancy. (Adler & Liebert, 2014) indicate that, irrespective of ownership form, regulation is necessary to emulate competitive forces thus pushing airport management towards cost efficiency and reasonable pricing policies. (Ahn, Y-H., & H. Min, 2014), focusing on operating efficiency for a dataset of 23 world airports in 2006-2011, concluded that operational efficiency is influenced more by exogenous factors (such as regulation) than endogenous (managerial) decisions. (Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang, 2012) examining the effect of regulatory regimes on airports' aeronautical charges, find the following. First, single till regulation and ex post regulation (*i.e.*, monitoring rather than directly regulating the aeronautical charges) lower prices charged by the airports to their customers (airlines). This should increase traffic at an airport, other things equal. Of course, the impact of lower charges on airport profitability will depend on demand elasticity – this issue was not covered in the paper. Second, price cap regulation does not appear to affect the aeronautical charges in any meaningful way with respect to an unregulated scenario, keeping competition level constant. The most

[40] In theoretical papers, social welfare is defined as the sum of consumers' and producers' surplus. From the empirical perspective, the measurement, especially of the consumer surplus, is not a trivial issue; often this translated into looking at prices (aeronautical charges in this context).

[41] Congestion arises because airlines do not account the costs they impose on other carriers when choosing how many flights to schedule (in an airport that is not otherwise capacity-controlled). The idea behind the airport congestion self-internalization hypothesis is that a dominant airline will schedule fewer flights as compared to a non-dominant carrier at an airport, because in the former case the congestion impact will be felt by the dominant airline itself, and should therefore be incorporated into the dominant carrier's decision-making.

recent study examining the effect of regulatory environment on aeronautical charges is (Conti, M., A.R. Ferrara, & M. Ferraresi , 2019).[42] The authors of that study find that the implementation of the EU Airport Charges Directive did lead to a reduction in aeronautical charges, albeit with a delay. The degree to which the Directive has been transcribed into the national legislation has played a significant role in determining the magnitude of that effect.

3.2.8 Competition and complementarity with other infrastructure

The relationship between air and surface transport is a bit more complex than one can suspect at the first glance. Surface transport links can be both complements to and substitutes for air travel. While high-speed rail has severely decreased the share of air travellers on some routes (*e.g.*, Paris-Brussels, Paris-Lyon, Paris-London, London-Brussels, Madrid-Barcelona markets); it is also true that accessibility of an airport by rail can work to expand its catchment area, potentially increasing competition between the airports. In fact, Air France-KLM, Lufthansa and United Airlines have code sharing arrangements with the train operators for some short-haul high-speed train services to/from their hubs (Paris Charles de Gaulle, Amsterdam Schiphol, Frankfurt, and Newark Liberty airports).

One can question the relevance of this issue to regional airports, given that the markets named in the above paragraph all involve larger metropolitan areas. However, the issue of competition with surface transportation at large (including such modes as intercity buses and personal cars) is relevant throughout the industry, at least as far as short-haul routes are concerned.

(Merkert, R. & Mangia, L. , 2014) construct two competition measurement models using Norwegian and Italian airport data. They find that the lack of infrastructure in Norway significantly affected competition.[43] Their overarching observation is that non-airport competitors offer complementary benefits as well as alternative choices. For example, where railways are not in direct competition with an airport, the railway often provides a complementary service to the airport customers and vice versa, and hence, contributes to improving the overall operational efficiency of the airport.

We should however stress that most of the literature on this topic focuses on effects of surface transportation options available on the airlines side, rather than the airports. (Takebayashi, M. , 2014) analyses a passenger transport market model taking into account competition between air and high-speed rail (“HSR”) systems in Japan and Europe. In terms of profitability, he found that, in Japan, there is an incentive for airlines to cooperate with HSR, but there is no incentive for HSR to cooperate with airlines. In some European markets, cooperative relations between airlines and HSR exist such that both profits and passenger benefits can be secured – in theory, he hypothesized that cooperation can lead to the effective use of runways with a tight capacity constraint.

The consensus from studies modelling the intermodal competition is that airlines generally respond to competition with surface transportation by reducing their capacity and/or fares. (Albalate, D., G. Bel, & X. Fageda, 2015) find that airlines do not modify their service frequency;

[42] The airports included into the study are those with 2 – 20 million passengers per annum.

[43] Compared to Italy, Norway lacks both high speed railways and extensive motorways in areas beyond a 2-hour driving radius of a metropolitan area.

instead they alter the specific aircraft assigned to the flight and in doing so reduce the number of seats supplied on HSR competing routes. (Ha, H., & Y. Park , 2006) and (Behrens, C., & E. Pels, 2012) study the Korean network and London-Paris market respectively to conclude that airlines also have an incentive to lower fares to encourage less passengers to substitute for other modes. (Bilotkach, V., X. Fageda, & R. Flores-Fillol, 2010), however, paint a more subtle picture. They argue that on shorter-haul routes where air travel competes with surface transportation, airlines have an incentive to increase flight frequency with longer distance. Data from the European markets render support to this hypothesis.

Whilst one can suggest from the available evidence that competition with HSR services can reduce the available airline seat capacity on the affected routes; it is not entirely clear what the effect of complementary nature of the HSR would be on the traffic handled by an airport. It is also unclear what level of airport ground access would be socially optimal, and what level will be chosen by an airport depending on its ownership structure (*e.g*., whether a privately owned airport would choose to locate an HSR station on its premises, and whether having such a station at an airport represents a socially optimal outcome).

3.2.9 Other factors influencing airports' economic performance

Other factors which may influence airports' economic performance are seasonality and the macroeconomic trends.

As to *seasonality*, the available studies indicate that regional airports that disproportionately rely on leisure travel face significant economic challenges during the off-season:

In 2007, (Tsekeris, T. , 2010) analysed the efficiency of Greek airports (using Data Envelopment Analysis) in terms of number of passengers, amount of cargo, and number of flights and found significant seasonality influences. In particular, airports with increased tourist movements need to adopt suitable measures to address the underutilisation of their facilities during the winter periods in which there are statistically significant losses in efficiency. (Tsekeris, T. , 2010) proposed suitable measures such as more flexible design or configuration of terminals to align with the needs of carriers and strategies for attracting alternative winter tourists;

(Zuidberg, J. , 2017) found instead that the relationship between year-round operations and profitability is non-linear: very low variation[44] leads to capacity constraints and therefore low profitability. Medium seasonal variation is associated with high profitability, and finally, very high seasonality lowers profitability due to an inefficient use of resources;

Commercial civil aviation as a sector is sensitive to business cycles. High capital intensity and significant share of fixed cost can make aviation infrastructure sectors (airports and air navigation services) particularly vulnerable to macroeconomic downturns. In fact, (Adler, N., Ulku, T., Yazhemsky, E., 2013) found that a 10% reduction in cost efficiency has occurred over the preceding decade, mostly due to large increases in costs without matching increases in

[44] Variation of seasonality is simple ratio between the lowest and the highest monthly traffic volume in a year.

revenues.[45] The general trend of increasing costs may be partially explained by exogenous factors such as 9/11 and the resulting regulations that ensued globally.

Between 2007 and 2009, (Voltes-Dorta, A. & Pagliari, 2012)studied 194 airports in Europe, Asia, and North America and – using Stochastic Frontier Analysis (SFA) – estimated that the average cost efficiency decreased by 4.8%, 5.9%, and 6.5%, respectively in those regions, during the financial crisis. For the same time period in Spain, (Coto-Millán, P., Casares-Hontañón, P., Inglada, V., Agüeros, M., Pesquera, M.A. & Badiola, A., 2014) – using Data Envelopment Analysis – found that the productivity of Spanish airports fell by 8.2% during the financial recession.

3.2.10 Summary

The following are the key takeaway messages from the discussion offered in this section:

- the relationship between airport size and profitability, while an important one, remains under-researched. There is some evidence of a positive link between airport size and technical and scale efficiency. In theory, high share of fixed costs implies airports require minimum traffic level to break even. However, the literature did not produce a clear understanding of what this level might be;
- there is evidence that privatisation and/or private sector management of airports is associated with improved efficiency, even though the relationship might not be a linear one. Some studies indicate that partially privatised airports are less efficient than fully publicly owned ones as, overall, managerial autonomy stands out as a key factor in increasing airport efficiency;
- while interpreting the previous conclusion, we should be mindful of the possibility of the causality running in the opposite direction. Better run airports might be more attractive privatization targets, and this could yield the privatisation-efficiency relationship observed in the literature;
- with respect to competition between airports, two forces are at play. On one hand, increased competition might lead to higher efficiency of the affected airports. On the other hand, as pointed out in some studies, competition between smaller regional airports may create cannibalisation effects. On the balance, available evidence points to competition between airports leading to increased efficiency. This could be due to the fact that competition between airports is prevalent in the well-connected larger metropolitan areas, capable of sustaining several airports of sufficient scale. However, more work is needed in this area, especially to take into account potential demand constraints and scale efficiencies;
- while there is a growing body of theoretical literature examining the impact of economic regulation on airport performance; empirical studies on this important subject are at their infancy;

[45] Using Data Envelopment Analysis, cost efficiency focused on labour and materials costs related to number of passengers, air traffic movements, metric tons of cargo, non-aviation revenues. Fixed factors were gross floor area of terminals, runway length, number of gates/check-in desks/baggage claim belts.

- evidence on the effects of an increase in the LCC share of traffic at the airport level is still scarce; a key factor is clearly the long run sustainability of airport's incentive programs put in place to attract LCCs, which depends on many other factors: the ability of the airport to build a durable relationship with the carrier (as retention once incentive programs fade away), to leverage a high share of non-aviation revenues, the response of other competing airports which may lead to cannibalization. Current developments in the LCC business models in Europe do not appear favourable for the smaller regional airports, as the carriers hold greater negotiation power; moreover, they appear to be increasingly looking at the large airports to capitalize on business travellers.

In short, several factors can contribute to the operational efficiency and profitability of small and regional airports. While considerable research has been devoted to the issue of analysing the drivers of airport efficiency, a number of key issues have remained unanswered to date. Perhaps the biggest gap in the academic literature to date is the dearth of studies on determinants of airport profitability. We further believe that the impact of ownership structure and regulatory environment on airports remain particularly understudied.

3.3 REGIONAL AIRPORTS AND REGIONAL DEVELOPMENT

3.3.1 Direct, indirect, induced, and catalytic impact

Whether they operate independently and profitably or not, airports may also have important effects on a region's economy. They can be important catalysts for economic activity, which may make sustaining them beneficial for the wider public. As for any infrastructure project, the assessment of the economic impact of regional airports in their locality can be split into four components:

- **direct impact**: this mostly comes from employment and other revenues directly created at the airport;
- **indirect impact**: is generated through the employment and business created from the various suppliers of services to the airport;
- **induced impact**: is the positive impact from the increased spending in the area resulting from the direct and indirect impacts on employment;
- **catalytic impact**: comes from the overall economic activity and productivity gains deriving from the increased attractiveness of the regional economy resulting from the presence of the airport in the region.

What people generally have in mind when discussing the impact of regional airports is especially the fourth channel: whether the presence of an airport helps the region develop above and beyond the employment, business, and spending the airport generates directly and indirectly. In this section we further elaborate on the different types of impact mainly focusing on the report published by (InterVISTAS, 2015). The broader set of studies that investigate catalytic impacts are presented in section 3.3.2.

The 'direct impact' is defined as the employment impact due to the presence of an airport and can usually be easily measured. (InterVISTAS, 2015) surveyed 125 airports, representing approximately 71% of air traffic in Europe recording their passenger numbers and all employment at the airport including retail services within the airport. They find that:

- for airports with less than 1 million traffic units, each increase of 1000 traffic units increases employment on average by 1.2 jobs. For airports with 1-10 million traffic units, each increase of 1000 traffic units increases employment on average by 0.95 jobs. For airports with over 10 million traffic units, each increase of 1000 traffic units increases employment on average by 0.85 jobs. Therefore, there are diminishing returns on direct employment as airports increase their traffic unit processing;
- connecting passengers generate 3% less direct jobs than origin/destination passengers;
- LCC passengers generate 20% less direct jobs than non-LCC passengers.

The indirect and induced effects crucially depend on how much the increase in demand of goods and services are sourced from the region itself instead of other, surrounding, regions (InterVISTAS, 2015). Therefore, from a theoretical perspective:

- the *indirect impact* will be larger if direct aviation activities source a significant proportion of their supporting services and supplies from within the region/country. This would be the case in places with a longer tradition of hosting aviation activities or which have large aviation manufacturing or supply industries (*e.g.* oil refining, companies providing accounting and legal services to airlines, travel agents booking flights, etc.);
- the magnitude of the *induced impact* in turn, depends on the degree to which increased earnings due to employment at the airport or at businesses located in the region are spent in general and, specifically, the degree to which they are spent on *domestic* or *local* goods and services.

(Bråthen, S., Johansen, S. & Lian, J. I. , 2006) studied four large and medium sized Norwegian airports (Oslo, Bergen, Molde and Leknes) using a Keynesian I-O model to calculate the indirect and induced impacts of air transport as defined by the multiplier of all direct and indirect effects divided by the direct effect. They find that the impacts are more significant in larger than in smaller regions (as Oslo multipliers are close to 2, while for the smaller airports in the study they range from 1.25 to 1.55)[46]. This can be explained partly by the fact a larger region can absorb more of the impacts within the regions, and partly because the industrial structure is "more modern" (contains more services production) in larger regions. Secondary impacts, especially the induced impacts, are larger in the sectors producing services than in those producing physical products, thus the services-producing regions can absorb more of them than the regions with more traditional industries.

The main objective in supporting regional airports is to generate catalytic effects. These are the wider economic benefits and capture how an airport facilitates economic activity in a region. Air transportation can benefit the economy through several mechanisms (InterVISTAS, 2015):

- trade: airports facilitate access to export markets for goods and services;

[46] These multipliers indicate the size of indirect economic effects relative to direct ones.

- investment: an airport can make a region more compelling as a location for offices, plants, warehouses, and other sources attracting capital expenditure;
- productivity: independent of the above mechanisms, an airport might enhance the productivity of local businesses by granting them access to a wider range of employees/customers or allowing them to leverage certain economies of scale;
- tourism: apart from business purposes, air transport makes a region more accessible for leisure travel. This in turn supports tourism-related businesses such as hotels, restaurants, and entertainment.

While catalytic economic impacts of airports are crucial in determining their overall economic profitability for a region, they are also the most difficult to measure. In section 3.3.2, we discuss the main empirical studies measuring the effects of airports and the resulting air traffic and accessibility on a region's economy. The findings are also summarized in Annex A.

3.3.2 Empirical evidence regarding regional economic growth and air traffic

The literature offers a good number of studies focusing on evaluating both the direction of causality and the effects of air traffic at the airport level on economic development. Most of the studies are looking at the regional and local level effects, using generally well available data on both airport-level traffic volumes and indicators of regional economic development.

We should note that studies of the effect of air traffic on regional development deal with evaluation of the marginal effects. Strictly speaking, one cannot draw conclusions from those studies on the effect of presence or availability of a regional airport itself. Rather, the estimated elasticities of the regional development metrics (such as employment or GDP) with respect to the airport traffic volume give us an idea of the overall effect of a small change in traffic volume on a chosen metric.

The key challenge associated with looking at this issue is that of endogeneity that is inherent in the data: an unobserved (to the researcher) shock to regional development can also trigger a change in the level of traffic handled by the regional airport. From the econometric analysis point of view, this produces correlation between the error term and the independent variable, rendering conventional estimates biased and inconsistent. The key methodological issue in analysing this question then becomes that of finding what economists call instrumental variables – correlates of air traffic that do not themselves correlate with the unobserved shocks.

In the European context, the issue of direction of causality has been scrutinised by (Van de Vijver, E., Derudder, B. & Witlox, F. , 2016) and (Mukkala, K. & Tervo, H. , 2013). The former study finds that the influence of air transport on regional employment is more marked than the influence of employment on air transport. In particular, in 43 out of 112 NUTS 2 regions, air passenger volume is found to cause an increase in total employment, while for another 10 regions, total employment causes an increase in air passenger volume. Lastly, in 4 out of the 112 regions, bidirectional causality occurred.[47] (Mukkala, K. & Tervo, H. , 2013) found that airport activity causes[48] economic growth in remote regions, while only the reverse is true in core regions *i.e.,* in core regions airport activity does not cause growth, but growth causes airport activity. They measured airport activity according to the number of air passengers and regional development using both overall employment and purchasing power corrected real GDP.

(Van de Vijver, E., Derudder, B. & Witlox, F. , 2016) also suggested differences in causal effects across sectors and regions. Causality from air transport to employment is stronger for the services sector, notably in regions most affected by tourism. Some of these effects can also be observed in the manufacturing sector, mainly in regions with high levels of manufacturing employment such as North-Western Italy and Scotland. The authors found clusters of positive impact of air traffic on employment (in terms of GDP in that geographical location) in the central, well-developed regions of Germany and Austria regions and in the coastal regions of Spain. However, these effects are notably absent in similarly well-connected areas such as the French and Dutch capital regions. They are present yet again in more peripheral regions such as Malta, Estonia and Vest (Romania).

It is important to note that studies focusing on direction of causality should not by themselves be used to obtain reliable estimates of the magnitude of effects of air traffic on regional development. The methodological approaches used to evaluate the direction of causality do not normally account for other relevant control variables.

Another study focusing on regional differences is (Allroggen, F. & Malina, R., 2014). The authors focused on the effects of investment in airport infrastructure, examining the data from 19 German airports from 1997 through 2006. They found that in first-tier, i.e. largest, (Frankfurt and Munich) or second-tier (Dusseldorf, Cologne, Stuttgart, Berlin, Hamburg) airports, the investment in capital alone does not have a positive effect on output since the opportunity costs (*i.e.* alternative uses of the same capital) are large.[49] Output measure is the price-adjusted GDP in 2000; with inputs including hourly adjusted labour force, aircraft movements, average road and rail travel time to the nearest economic centre, population, and the relative importance of the airport as part of the German transport system. The investment effects in third-tier airports (roughly those with less than 10 million passengers per year) are larger because the opportunity costs of capital are lower. In addition, capital investments in more peripheral areas may suggest higher policy focus on the region, thus triggering business investment. Third-tier airports (most of which are located in peripheral regions) also offer additional connections to domestic hubs and other economic centres. Thus, capital investments in these airports, together with other services, may increase core connectivity, which has a positive impact on the economy.

In contrast, a recent quasi-experimental study of German regional airports concluded that investment in regional airport infrastructure did not contribute to GDP per worker (Breidenbach,

[47] The authors use a heterogeneous Granger causality-methodology. Causality in this sense refers to a chronological precedence of one variable to another.
[48] Causality is interpreted again in the Granger sense.
[49] Opportunity costs of airport capital are defined as the yearly output from an alternative appropriation of airports' capital in the economy.

P., 2015).[50] The author used 1991-1996 data on NUTS 3 regions in Germany as the pre-treatment period and data from 1997-2008 as the treatment period. The treatment in this paper refers to completion of the EU airline market liberalisation in 1997, which has changed the structure of the airline markets within the EU and had profound implications for regional airports.

(Redondi, R., Malighetti, P. & Paleari, S. , 2013) demonstrate the importance of regional airports from a different angle. In their study of all the 75,000 municipalities in 19 countries in Western Europe, they found that average travel time for consumers would increase by 1.5% if very small airports[51] were to be closed and by 2.5% if small airports were to be closed.[52] While these travel time increases may appear insignificant, (Redondi, R., Malighetti, P. & Paleari, S. , 2013) results indicated that in terms of spending, the affected travellers would incur costs that total to €1.7 billion per year, if both very small and small airports were to be closed. Upon examining accessibility and connectivity issues at a singular country level (instead of Western Europe as a whole), (Redondi, R., Malighetti, P. & Paleari, S. , 2013) found that connectivity loss is unequally distributed and in some regions in Scandinavia, France, Spain, and Italy sustained travel time would increase of up to 40%.

(Rey, B., Myro, R. L. & Galera, A. , 2011)and (Graham, A. & Dennis, N., 2010) investigate the effect of air transport on tourism. The former study observed that the expansion of LCC activity in Spain between 2000 and 2009 had a strong, positive effect on the number of tourist arrivals in the affected regions. The latter paper found that new LCC operations incentivised by the Maltese government in 2006 increased air traffic tourism from the UK to Malta. In particular, LCCs attracted younger, more affluent, and first-time visitors. The magnitude of the effect however was not clearly identified by the authors.

(Cooper, A. & Smith, P., 2005) and (Bel, G.; Fageda, X., 2008) consider the issue of the impact of air transport on investment and business activity in the region.[53] The former study focused on European airports and found that an increase of 10% in air transportation usage increased business investment by 1.6% in the long run. The latter paper studied 87 European cities and found that a 10% increase in the provision of intercontinental flights involved around a 4% increase in the number of headquarters located in the corresponding urban area. One should however approach such elasticity estimates, averaged across various regions, with caution, especially when applying them for policy work related to airports that are different from the average for the samples analysed in those studies.

While most of the studies of effects of air traffic have a regional focus; an exception from this rule is a (PWC, 2014) study, that analyses the impact of aviation on the entire UK economy. In

[50] The growth of GDP per labour force can capture the range of assumed spill overs from regional airports to regional prosperity. Therefore, the growth of nominal GDP per labour force is used as the main outcome variable. Further robustness checks were also applied with the growth of total GDP, GDP per capita and employment as dependent variables.

[51] The authors labelled airports handling fewer than 1 million passengers per year "very small". Small airports are – in authors' classification – those handling between 1 and 2 million passengers per year.

[52] Very small airports were defined as those with less than 1 million passengers per year. Small airports were defined as those with 1-2 million passengers per year. (Redondi, R., Malighetti, P. & Paleari, S. , 2013) took data from 16 Western European countries. Norway, Sweden, and Finland had the largest number of very small and small. In all, 379 Western European airports were included in the 2011 study.

[53] Causality is assumed to go from air travel to regional development.

particular, this study found that a 10% increase in air seat capacity could increase export of goods by 3.3% and goods imports by 1.7%; lead to a 4.7% increase in foreign direct investment ("FDI") inflows and 1.9% in FDI outflows. Further effects include a 1% increase in short term UK GDP growth, and 4% higher tourism within the UK, as well as a 3% increase in the UK outbound tourism.

Last but not least, it is worth mentioning a number of studies in the literature utilising US data to study the effect of passenger traffic on indicators of regional development – most often employment. Notable works here include (Brueckner J. , 2003); (Blonigen, B., & A. Cristea, 2012); (Sheard, N. , 2014); (Bilotkach, V., 2015); (Lakew, PA, & V. Bilotkach , 2018). Effect of air cargo traffic on urban development has been measured by (Oster, C.V., B.M. Rubin, & J.S. Strong , 1997); (Kasarda, J.D., & J.D. , 2005); Green (2007); (Button, K., & J. Yuan, 2013). Overall, these studies confirm the positive impact of air traffic on regional development, both in the aggregate terms, and specifically for service industries. We should note that the reported effects can in most cases be considered as average among all the airports. No studies specifically focus on regional airports; thus, we do not know how much the effects for smaller airports are different from those averages. Again, causality is assumed to go from aviation to development, with the exception of (Button, K., & J. Yuan, 2013), who run Granger causality test and show that air cargo causes growth. Last but not least, we should note that some of the elasticity estimates reported in those studies, are reasonably close to each other, even though they are based on the data from different time periods. For instance, (Lakew, PA, & V. Bilotkach , 2018) report elasticity of service sector employment with respect to air traffic, which is similar to that estimated by (Brueckner J. , 2003).

3.4 PUBLIC SUPPORT OF REGIONAL AIRPORTS

The aviation industry is an industry where subsidies are prevalent around the world: manufacturers, airports, airlines, all have received or continue receiving help from public authorities. Public aid to airports in general, and regional airports in particular, can take many forms, including infrastructure investment, operating subsidies, and cross-subsidisation between large and small airports. The premise for subsidising the regional airports is in the belief that the market will likely not provide socially optimal level of airport infrastructure, as market participants will not take into account all the indirect benefits of aviation. It can be surmised that there is a particular socio-economic benefit in connecting residents of remote areas to the larger regional or national grid for health, educational, or business purposes via air transport (Bråthen, S. , 2011). It is often the very remote regions that would benefit the most from financial aid in social and economic terms, albeit they would likely require large and extended subsidies. This section attempts to summarize the evidence on cost and benefits of public support of regional airports, ranging from regional accessibility to economic development; the role played by externalities is also considered.

According to (Special report of the European Court of Auditors , 2014), based on their study of public investment in EU airports, too many oversized airports that were often close in proximity to one another received funding. Many of the supported airports risk closure without continuous/indefinite public financial support. This is particularly the case with small regional airports having fewer than 100,000 passengers per year (Special report of the European Court of Auditors , 2014). Only half of the audited airports succeeded in increasing their passenger numbers. Additionally, improvements in customer service were either not measured or not evidenced (Special report of the European Court of Auditors , 2014).

The evidence on the impact of public subsidies – either to the airport itself or to carriers operating in the airport – on the airports' profitability is rather scant.[54] (Barbot, 2006) considers the effect of subsidising reduced aeronautical charges to the airlines – mostly Ryanair – using Charleroi airport in Belgium. The author concludes that these subsidies were harmful to the incumbent airlines, even though they did help the passengers, as Ryanair passed some of the corresponding cost savings to its customers through lower fares.

There is neither clear indication that public subsidies to airports produce benefits for the regions. (Breidenbach, P., 2015) offers an analysis of the effects of infrastructure investment subsidies provided to the German regional airports, finding no positive spill over effects for the regions. Thus, the few available studies of the effects of public support of regional airports do not show evidence of such subsidies producing significant benefits. At the same time, we believe it is too early to generalize this evidence to suggest that the public support is ineffective. We would require more case studies and analysis to reach some general conclusion here.

At the same time, we cannot ignore the evidence suggesting that public support to the airports appears to be in part driven by the political rather than economic consideration. For instance, airports might be prioritised on the basis of the political importance of the regions[55]. The degree of a region's political importance may depend on such factors as the level of support of the political party in power, or the issues relevant to the region's voters. Interestingly, in a recent discussion of available policies to increase connectivity of the remote regions (Fageda, X., A. Suárez-Alemán, T. Serebrisky, & R. Fioravanti, 2018) suggest that policies targeting the airlines, such as Public Service Obligations ("PSOs") rather than airports are likely to be more effective.

The available literature does not allow to identify the causal relationship between public subsidies and airports profitability or regional/national spill overs. Yet, even in the case the public subsidies improve airports performance and profitability, the existence of regional benefits should be carefully assessed as one way to evaluate whether the public support is worthwhile. The studies reviewed in section 3.3 provide some evidence of economic gains of increased accessibility through regional airports, suggesting that public support, which results in or is targeted at increased accessibility or connectivity could bring tangible benefits to the regional economy. These studies try to disentangle the bi-directional nature of the economic relationship between

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[54] Although none of the existing studies investigate the impact of public aid at airport level, many studies assess the determinants of public infrastructure investment in Europe, which may in turn affect the effectiveness of the granted investment aid. (Bel, G.; Fageda, X., 2008) finds that political motivation appears to play a higher role than social welfare considerations in determining allocation of airport investment in Spain. (Bilotkach, 2018) finds that political consideration plays a role in allocation of federal airport infrastructure funds in the USA.

[55] (Bel, G.; Fageda, X., 2008) use the following political variables in their analysis: the difference in popularity of the main political parties; whether the regional government is run by the same political party as the central government; and the percentage of votes obtained by the political party currently in power in the central government.

airports and regional development and have attempted to measure the impact of accessibility by air on the regional economy. However, the following caveats should be taken into account.

First, a regional economic gain is not always a national or global one: what appears in the data as a regional gain might simply represent a diversion of economic activity from a different place. For instance, (Bråthen, S., Johansen, S. & Lian, J. I. , 2006) in their survey of employment at all Norwegian airports found evidence that some gains in air traffic and economic activity will, to some extent, divert traffic from other airports and/or redirect business activity from other locations.[56] The authors calculated the costs of a 10% diversion of air traffic to other transport modes at NOK 2.1 billion per year, under reasonable assumptions on the value of time and travel time savings. Some of these saved costs due to air travel are expressed through higher productivity and a more effective geographical division of labour. Some of the cost savings devolve onto private travellers.

Taking into account this diversion of traffic and other economic activity may have implications for the estimates of the effects of air traffic. For instance, in a study of passenger air traffic at various Italian airports, (Percoco, M. , 2010) found an elasticity of service sector employment to airline traffic of about 0.056. This elasticity is reduced to 0.045 when accounting for the effects of diversion of activity from other regions. More generally, based on his cost-benefit review of European airport subsidies in all Eurozone countries, (Forsyth, 2007) found that their *overall welfare effect* is more likely to be positive only if the region offering the subsidies is relatively depressed compared to other regions that are not.

Second, while there is consensus that accessibility matters for economic activity; accessibility is not always directly driven by the existence of the airport infrastructure per se. (Falcidieno, M. L. & al., e., 2012), for instance, note that even in regions that have an airport, there is too little availability of regular flights to significant hubs. Whereas in regions within a reasonable distance from a larger airport, improvements in road or railway connectivity may improve accessibility in a more meaningful way rather than investments in a regional airport.[57]

Next, there is the issue of opportunity cost of airport infrastructure investment. Coming back to (Falcidieno, M. L. & al., e., 2012) study, the authors found that it is better to use a larger airport in a neighbouring region than to develop an airport of its own due to high upfront capital requirements. They also propose that some existing in-decline airports can be closed with the land used for something more efficient such as new housing or urban park space. (ITF , 2014) covers the issues related to expansion of airports in large urban areas rather extensively, including an in-depth consideration of various option to more effectively use the existing airport capacity before considering construction of a new airport.

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[56] The 41 airports are sorted into five categories: large, medium, regional, other, and Oslo. The study took place in January 2005. Business activity refers mostly to direct employment effects collected from employment data registers at each airport listing all tenants and service provides – these were also divided into five business activity categories: government (customs, police, security); land and air transport (fuel, taxis); private services (parking, car rental, cleaning); hotels and restaurants; and telecom (cargo handling).

[57] (Falcidieno, M. L. & al., e., 2012) distinguish between two types of regions: regions which are close (up to 3-4 hours via rail or road) to a well-functioning airport; and regions beyond that.

Airport operations are finally generally associated to negative externalities. Note that externalities are a distinctly different phenomenon from diversion of economic activity from the nearby regions, as discussed in previous sections 3.2.3 and 3.2.7.

Aviation is a key source of several air pollutants, emitted during taxiing, take-off and landing, and cruising at altitude. In addition, emissions from the numerous ground support services, such as ground vehicles operating at or around runways, airport heating, and transport to and from airports by passengers and freight services, significantly contribute to the emissions of air pollutants (EEA, 2017).[58] (Schlenker, W. & Walker, W. R. , 2015) estimate the causal effect of the increase of air pollution due to airport congestion and its subsequent effects on the local population's health. Their results suggest that ground operations at airports are responsible for a large amount of local ambient air pollution. Infants and the elderly show a higher sensitivity to pollution fluctuations, and marginal damages of pollution seem to be increasing in pollution for infants.[59] This makes air pollution through aviation a particular health risk for populations living in the proximity to an airport.

The exposure to aircraft noise is associated with issues such as sleep disturbance, annoyance, nervousness and increased blood pressure, as well as with clinical symptoms such as hypertension, cardiovascular diseases and cognitive impairment in children (EEA, 2017). For an extensive review of the health risks related to noise exposure, see for instance (WHO, 2018.). Other negative externalities caused by airports include land use pressure (impact on the potential use of surrounding land), waste production, increase in water demand and water pollution, in particular through de-icing fluids (EEA, 2017).

We should however note that in fact the negative externalities attributed to air transport development are usually discussed without consideration of the alternative means of achieving the regional economic development. Alternative feasible and equally effective transport infrastructure strategy that would achieve the same level of development would normally also be associated with negative externalities, which tend to be ignored in the relevant literature.

The issue of positive externalities of the airport operations is a tricky and an unexplored one. However, the positive externalities that can be associated with the air traffic are more relevant for large hubs than for regional airports. Specifically, we can talk here about spill over effects associated with the economies of agglomeration, and with the hub operations. Agglomeration economies relate to cost savings associated with the clustering of economic activity (high technology clusters such as the one located in the Silicon Valley are a textbook example here). While we can suspect that aviation facilitates such clusters, there are no studies that would

[58] The health impacts of air pollutants caused by aviation are influenced by several factors, including the altitude at which pollutants are emitted. The largest health impacts are caused by air pollution at ground level due to proximity to human populations, further influenced by local weather conditions and the type of pollutants

[59] Specifically, they find that a one standard deviation change in daily taxi time at Los Angeles' LAX airport is responsible for a 0.28 standard deviation increase in levels of carbon monoxide (CO) next to the airport that fades out with distance. The average impact for zip codes within 10 km is 0.23 standard deviations. When connecting these models to measures of health, they find that admissions for respiratory problems and heart disease are strongly related to these pollution changes. A one standard deviation increase in daily zip-code specific pollution levels increases asthma counts by 17% of the baseline average, total respiratory problems by 17%, and heart problems by 9%.

measure the extent (if any) of such facilitation. Hub operations, on the other hand, use transfer passengers to increase the number of destinations with direct service, as well as flight frequency. This may have an effect of making an area more attractive for multinational companies (as documented by (Bel, G.; Fageda, X., 2008)'s work we discussed in the previous section 3.3.2). Another case that comes to mind is the work of the UK Airports Commission. In its report, the Commission recommended to the UK Government to invest into the third runway at London's Heathrow airport rather than build the second runway at Gatwick. Connectivity benefits due to hub operations that expansion of Heathrow would enable played a central role in this recommendation.

However, given the nature of positive externalities in the airports sector, we can say that using agglomeration economies and/or connectivity benefits due to hub operations would probably be a questionable defence for justifying putting public funds into regional airports.

3.5 CONCLUSIONS

To evaluate the impact of state support and state aid on small and regional airports, it is important to understand the economics of these airports and the challenges they are facing in terms of economic viability. In this review, we have discussed several factors influencing the sustainability of regional airports. These have included air traffic size, ownership structure, competition and cooperation with other airports and other transport infrastructure, their dependence on LCCs, as well as seasonality and the macroeconomic environment.

One key conclusion from the review of available evidence is that the relationship between airport size and profitability, while an important one, remains under-researched. In theory, high share of fixed costs implies airports require minimum traffic level to break even. However, the literature did not produce a clear understanding of what this level might be. Existing literature demonstrate that larger airports benefit from economies of scale, and such scale economies are not exhaustible. There will inevitably be cases of airports – however efficiently run otherwise – not generating enough business to cover their operating and/or capital costs. Hence, it appears that the literature has converged towards a conclusion that regional airports need some form of support to survive, and that this support may be long-lasting. The issue is therefore whether such outside support can be justified by the positive economic impact these airports bring to their respective regions.

We have shown that there is a large body of literature that substantiates the claim that airports can be important facilitators of economic growth under some circumstances. Amongst other factors, air traffic has been shown (see 3.3) to have a positive impact on investment, GDP, employment (particularly in the service sector) and tourism in some regions. Some studies have found this effect to be particularly pronounced for the most remote areas that are truly inaccessible via existing trains or highways systems, and that those regions are especially depressed in comparison to other geographical settings. It can be surmised, therefore, that there is a particular socio-economic benefit in connecting residents of such areas to the larger regional or national grid for health, educational, or business purposes via air transport. It is often the very remote regions that would benefit the most from financial aid in social and economic terms, albeit they would likely require large and extended subsidies.

The issue of financial support for regional airports should be considered in light of the factors that have been shown to impact airports' efficiency and/or profitability. While, on the one hand, public support to privately owned airports can become a sensitive issue; we should keep in mind that privatised (especially fully privatised) airports tend to be more efficient than fully publicly owned ones. This means that private airports might require lower levels of support as compared to the airports in public ownership. On the other hand, the available evidence suggests that sound corporate governance might be a more important driver of efficiency than private ownership.

Regulatory environment could in principle be an important driver for airport efficiency. After all, the very purpose of incentive regulation mechanisms (such as price-cap) is to induce a regulated company to become more efficient. We should however note the following caveats here. First, establishment of airport regulatory framework is currently the responsibility of national authorities. Second, some (if not many) regional airports might not need to be subject to direct price regulation, as they tend to be exposed to competitive pressures already. Third, the existing literature on this subject is predominantly theoretical. Available empirical evidence is, generally speaking, scarce and inconclusive.

Competition between airports can work to increase airport efficiency and profitability. However, we should keep in mind that on smaller scale markets sharing traffic between nearby airports might make both of them less efficient through economies of scale. Incentives to attract new traffic, especially the low-cost carriers, have not been shown to increase airport profitability; however, we can expect higher traffic volumes to lead to higher profit levels, potentially reducing the need for public support. We should however keep in mind that available evidence does not point to long-term positive effects of incentives offered by the airports on profitability. Also, in the European context, large low-cost carriers tend to have an upper hand in negotiations with smaller regional airports.

At the same time, support for airports should be considered carefully, taking into account the caveats discussed in section 3.4. First, air traffic can have serious negative externalities in terms of air pollution, noise and other environmental considerations. Positive externalities, such as agglomeration economies or connectivity benefits due to hub operation, tend to be associated with the large hubs rather than smaller regional airports. Similarly, it is possible that increased access to one region has negative economic spill over effects on other regions. Secondly, the opportunity costs of funds used to support local airport infrastructure should always be taken into account – would inhabitants be better served if they were to receive such aid in an alternate manner? Other transport infrastructure may be equally or even more effective, at increasing accessibility and connectivity to remote regions. More generally, the impact of public investment on economic growth may be larger in other forms of investment altogether.

4 DATA COLLECTION

The Study is mainly based on data collected from airports through the survey. Section 4.1 briefly retraces the various steps of the data collection process. Section 4.2 briefly describes data collected from publicly available sources.

4.1 COLLECTION OF SURVEY DATA

To answer the research questions and comply with the objectives of the assessment, data at the airport level on past and expected financial performance and on airports' characteristics was needed. This data has been collected through a survey from airports located in different EU Member States. The Team has selected the sample, designed and circulated the survey questionnaires and collected the responses.

4.1.1 Characteristics of the sample

The Team was requested to select a sample balanced in terms of coverage of airports with different traffic levels (this is further discussed in the sub section "Representativeness of the sample"). Moreover, the sample had to:

- include airports that received operating aid during the period 2014-2018;
- include airports from at least 10 different Member States;
- include at least 45 airports;
- include at least 15 airports whose catchment area includes another existing airport (i.e. located within 100 kilometres or 60 minutes travelling time);
- include publicly operated airports in a proportion of at least 70%;
- exclude airports with less than 200,000 passengers, which are classified as SGEI under the Commission Decision 2012/21/EU.[60]

All requirements have been met. A total of 147 airports were contacted for the survey: 94 of them were contacted as a result of the initial project planning, while the remaining 53 represented a second wave of airports launched to reach a reasonable minimum sample size, as explained in Annex D that includes statistics on the total number of airports that have been contacted for the survey, and the number of responses received.

Out of the 87 responses received, 3 airports had to be excluded as they were services of general economic interest ("SGEI") and their passenger traffic was below 200,000 for the whole reference period.[61] The proportion of publicly operated airports in the final sample is 72.46%; the number of

[60] See footnote 10.

[61] There are only three airports that were entrusted as SGEI in a given year and recorded average annual passengers in the two preceding years of less than 200 thousand. However, these airports have not been excluded from the sample as during SGEI entrustment they record passenger mostly above 200 thousand (in only 1 or at most 2 years out of 9 they fall below this level), and in fact their average passenger traffic over the entire observational period is above 200 thousand.

airports whose catchment area as defined by the Aviation Guidelines includes another existing airport is 33.

The final sample is smaller than the number of responses received though, as a refinement was necessary based on the quality of the responses, as is further explained in section 4.1.2. This process led us to finally include 68 airports from 11 different Member States in the analyses. The composition and representativeness of the final sample are discussed in the section "Representativeness of the sample".

Representativeness of the sample

The Team was required to stratify the sample according to the five-class categorisation referred to in the Aviation Guidelines (point 118) and already introduced in section 0. This stratification is finer than the one on which aid intensity is based, and as such it is more suitable, given the objectives of the assessment (the finer categorisation is in fact nested into the one that determines the variation of aid intensity, where class 1 and class 2 were grouped together, at least until GBER was extended to class 1 airports in 2017). The stratification of the sample has been carried out using Eurostat data on passenger traffic by airport-year. As a reminder, the class definition is the following:

- **Class 1**: up to 200,000 passengers per annum;
- **Class 2**: passengers between 200,001 and 700,000;
- **Class 3**: passenger between 700,001 to 1 million;
- **Class 4**: passengers above 1 million and up to 3 million;
- **Class 5**: passenger above 3 million.

Based on annual traffic reported, airports have been assigned to one of the above classes, and precisely to the most frequent class the airport stayed in during the period 2014-2017.

Table 4.1 shows the distribution of airports included in the final sample by country and class, as well as the marginal distributions of all airports in the same countries, by class and by country.

The choice of airports to be included in the sample aimed at satisfying, on the one hand, the criteria set by the Commission, and, on the other hand, methodological requirements (i.e. sample representativeness). From a methodological perspective, the sample needs to reflect the situation of airports across the EU by class and within the different Member States, as well as to include a reasonable number of airports, in order to allow the Team to draw meaningful conclusions that can be generalized to airports not included in the sample. However, the Tender Specifications requirements (referred to as "TS target" in Table 4.1) reflected the focus of the Commission on airports whose size was more relevant for the fitness check of the Aviation Guidelines, and were different with respect to the distribution by class of airports in the selected countries ("Target population by class" in Table 4.1).

At the stage of sample selection, a compromise between these two different needs has been reached with the Commission, leading to identify the benchmark for the sample selection in terms of a distribution of airport by class ("Revised target" reported in Table 4.1).[62]

[62] The compromise consisted in restricting the sampling pool by excluding airports with passengers never above 120k or never below 4.2m passengers between 2014 and 2017. The logic is that airports that did not satisfy these two criteria were unlikely to fall under the scope of operating aid under the Aviation Guidelines (when also considering the extension of GBER to class 1 airports in 2017). The total number of airports satisfying these criteria the selected countries amounts to 187.

Table 4.1. Final sample of airports included in the analysis (in units) (*)

Country	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k-1M]	Class 4 (1M-3M]	Class 5 > 3M	Total	Total (%)	Target Population by country (%)
AT	0	0	1	0	0	1	1.4%	1.5%
DE	1	3	1	2	0	7	11.6%	10.3%
DK	0	1	0	2	0	3	4.3%	4.4%
ES	1	2	3	3	1	10	14.5%	14.7%
FR	3	7	1	3	1	15	21.7%	22.1%
HR	0	1	0	0	0	1	1.4%	1.5%
IT	2	3	1	4	3	13	18.8%	19.1%
PL	0	3	0	0	0	3	4.3%	4.4%
RO	0	1	1	1	0	3	4.3%	4.4%
SE	1	3	0	2	1	7	10.1%	10.3%
UK	0	3	1	0	1	5	7.2%	7.4%
Total	8	27	9	17	7	68	100%	100%
Total (%)	11.8%	39.7%	13.2%	25.0%	10.3%	100.0%		
Target Population by class (%)	20.3%	34.8%	8.6%	27.3%	9.1%	100%		
TS target	10%	30%	20%	30%	10%	100%		
Revised target	21.7%	35.9%	9.8%	25.0%	7.6%	100%		

Source: Airports assigned to classes based on passenger data from Eurostat. Excluding airports with passengers never above 120k or never below 4.2m passengers between 2014 and 2017. Note: Airports are grouped into 5 classes based on *passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Class boundaries are reported in parentheses above each graph ("k" is a shortcut for thousands; "M" is a shortcut for millions).*

In the final sample, class 1 is relatively underrepresented with respect to its share in the by-class target population. Notwithstanding the efforts to increase participation through very intense follow-ups, class 1 came out as the hardest to pursue. The smallest airports, in fact, recorded the lowest response rate (47%, below the average of 59% of all airports) and a poor quality of responses received (50% did not provide enough data, versus an average of 79%).[63] An option would have been to rebalance the sample over classes by excluding some airports in larger classes. However, class 1 airports since 2017, fall under the GBER rules; second, total sample size is also relevant to draw meaningful results. Thus, given that sample size was already deemed small by the Team, size has been preserved. In this respect, even though sample size is not small relative to the total number of airports satisfying the sampling criteria[64], it is still quite small in absolute terms to draw general conclusions within class (especially as we want to analyse what are the differences in profitability determinants between classes). Moreover, the sample is also affected by the fact that some airports did not provide data for the entire sample period (as discussed in next section "Sample frictions"). Thus, results should be taken carefully.

Sample frictions

Sample friction in our sample only affects the first year since an airport provides data. In fact, some of the airports did not provide data for the full period 2010-2018, for several reasons: excessive burden to retrieve past data; changes in internal accounting management systems; changes of the managing entity/ownership.

Table 4.2 shows by class how many new airports join the sample in a given year (counting only the first observation in the sample). In the econometric analysis, we use fixed effects (by year and by airports) to control for unobserved heterogeneity, which might also be correlated with sample unbalance.

[63] As explained in section 4.1.2 not all responses contained enough data to be included in the analysis, which explain the difference between answers received and the final sample.
[64] See footnote 62.

Table 4.2. Airports in the sample by year of first observation and class (in units)

First year the airport is observed	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k-1M]	Class 4 (1M- 3M]	Class 5 > 3M	Total
2010	5	18	6	12	3	44
2011	0	3	0	0	2	5
2012	0	1	0	0	0	1
2013	0	2	0	0	0	2
2014	1	0	0	1	1	3
2015	1	3	3	4	1	12
2017	1	0	0	0	0	1
Total	8	27	9	17	7	68

Source: Team based on sample data. Note: Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Class boundaries are reported in parentheses above each graph ("k" is a shortcut for thousands; "M" is a shortcut for millions).

4.1.2 Data collected through the survey and survey stages

The circulation of the survey was aimed at collecting qualitative and quantitative information related to general characteristics of airports, the main competitive threats to which they are subject, their business model, their relationships with airlines and financial data for the period 2010-18. More precisely, the questionnaire was composed of two forms. The first form ("Section 1") had a more qualitative character and enquired about:

- general information on the current ownership of the airport and of the airport infrastructure, as well as SGEI status (*i.e*. whether and when the airport has served an SGEI entrusted by public authorities);
- the catchment area and competing airports; whether an airport is subject to significant competitive pressure from providers of other modes of transport;
- an airport's business model; measures implemented in the period 2014-18 to increase profitability; congestion;
- the identity of the main airlines serving an airport; whether or not an airport has been granting incentives to airlines in any form; past shocks deriving from airlines' decisions to leave an airport or reduce the number of flights/routes;

- general expectations about future trends of key performance indicators and underlying motivations;
- alternative measures of airport performance apt to better capture an airport's funding gap.

The second form ("Section 2") of the questionnaire aimed at collecting mainly quantitative data on operating and financial performance for the past (2010-2018) and for the next six years (2019-2024):

- the private or public ownership of an airport;
- data on traffic (passengers and freight);
- aviation and non-aviation revenues;
- operating costs, including incentives to airlines;
- public funding received to cover operating costs (operating aid, public remit or SGEI compensation);
- EBITDA;
- depreciations and amortizations;
- public funding received to cover investments;
- financing costs, taxes, etc.

Some of the information collected through Section 2 of the questionnaire was deemed essential for the airports to be retained in the sample, as this kind of information would not be available through alternative sources and was strictly needed in order to meet the objectives of the Study. Based on the essentiality of such information for the purpose of this Study, we have reviewed all responses received and excluded those that were not adequate (because they did not provide all the essential information or the information was not coherent with other pieces of information available). This assessment has determined the final sample size, already presented in section 4.1.1.

4.2 DATA COLLECTED THROUGH OTHER PUBLIC SOURCES

The information provided by airports has been complemented with publicly available information to control for the socio-economic and demographic characteristics of the territory of the airports' catchment area.

The source for this information is Eurostat, which provides regional statistics by NUTS classification.[65] In particular, information was taken from the following databases available on Eurostat:[66]

- regional demographic statistics: we use total population on 1 January by NUTS 3 region, available until 2017;
- regional economic accounts: it provides several indicators of economic performance; based on coverage, we selected gross domestic product (GDP) per inhabitant at current market prices by NUTS 3 region, available until 2017; and employment by NUTS 3 region, also available until 2017. Employment has been combined to population data, to compute the employment rate to population;
- regional transport statistics: it consists of information on road, railway, navigable inland waterway, maritime and air transport of freight and passengers, available until 2017. We use total national annual road freight transport by NUTS 3 regions of unloading, which is the variable with the highest coverage of regions and years.

In the final analysis, only data on total GDP per capita, population, employment rate and total road freight transport have been used to avoid losing too many observations due to missing data points in the socio-economic variables at the NUTS 3 level. Yet some missing data points remain: information is available only up to 2017 and there are some missing region-level data points within country.

[65] The NUTS classification, the classification of territorial units for statistics, is a regional classification for the EU Member States providing a harmonised hierarchy of regions. It subdivides each Member State into regions at three different levels, covering NUTS 1, 2 and 3 from larger to smaller areas. The Nomenclature of Territorial Units for Statistics or NUTS is a standard is established by Eurostat in agreement with each member state.

[66] Other variables were considered, but not used in the end because of missing data points (e.g. the regional business demographics database includes information on active enterprises, but the most recent data of this database is from 2016 and data was not available for all the regions included in the sample; also regional data on accommodations for tourists had too many missing data points in our sample).

5 DESCRIPTIVE STATISTICS

This section presents in a graphical way the main descriptive statistics for the key variables of interest in the analysis:

- measures of profitability: Operating Funding Gap ("OFG") is the baseline measure used in the analysis throughout the Study;
- passengers, relevant both as a key driver of an airport's profitability, as shown in the literature, and as the only criterion used to define thresholds of aid intensity;
- operating aid and investment aid;
- other determinants or dimensions of profitability that are investigated in the analyses that are: incentives to airlines, proximity to other airports (catchment area), number of competing airports, ownership type, networks of airports.

Additional technical evidence is instead provided in the Annex D and Annex E (Table and Graphs, respectively).

All descriptive statistics in this section and in the Annexes are shown according to the five-class categorisation over which the sample is stratified which is the same used in the Aviation Guidelines to stylize different performance dynamics at different airport traffic levels.

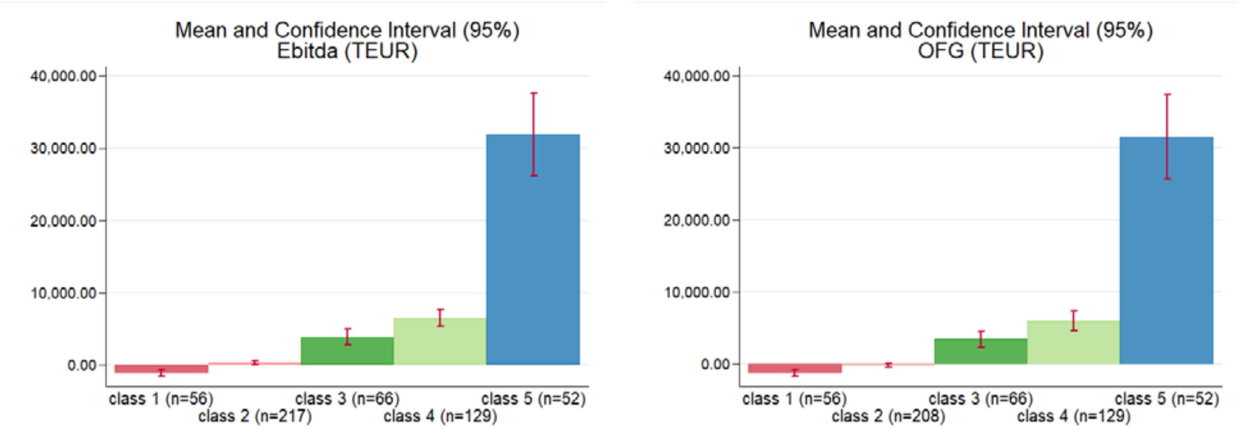
5.1 PROFITABILITY MEASURES (OFG)

OFG is EBITDA *adjusted* for all public resources that concern operating costs. This measure, defined by the Commission in the Aviation Guidelines, is meant to capture to which extent an airport is not able to cover operating costs with operating revenues, *i.e.* before any public support received.[67] In this Study we use it as the baseline measure of profitability (more appropriate than EBITDA in this context, but that, in the same way as EBITDA, can be either negative or positive), disregarding the fact that only a negative OFG over the transitional period is eligible for operating aid. Here we present OFG together with EBITDA to better grasp OFG characteristics.

EBITDA and OFG differ only for airports that receive operating aid (the number of which is reported in Table 5.1). On average, class 1 airports record a negative outcome in both EBITDA and OFG, while class 2 airports' average is slightly negative only in OFG.

[67] How OFG is defined and how the measure has been implemented based on the data collected is the subject of Section 6.1.1, where we discuss the methodological approach followed in measuring past and projecting airports' operating performance till the end of the transitional period.

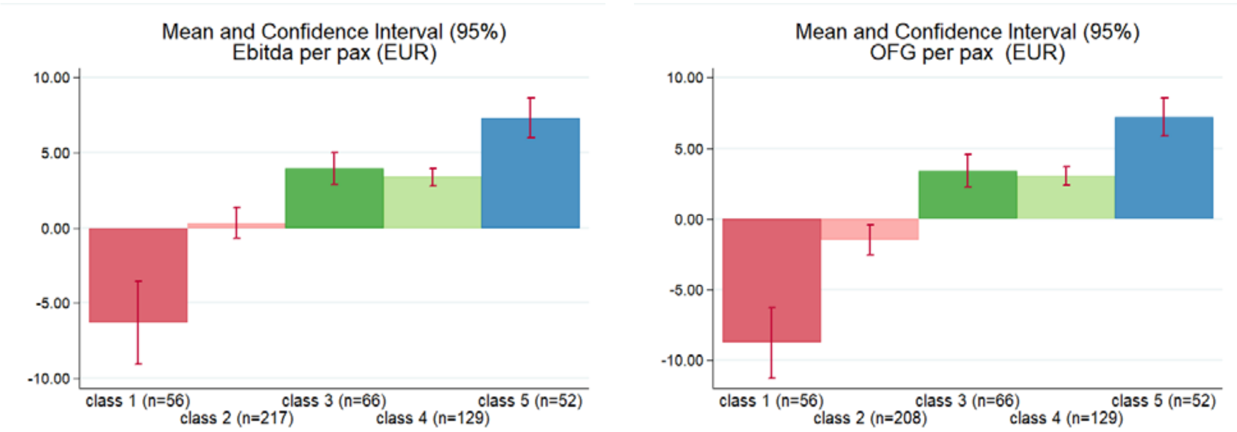
Figure 5.1. EBITDA and OFG



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines. OFG is the acronym of Operating Funding Gap. TEUR is thousands of Euros.*

To better see the situation of smaller classes, it is better looking at the ratio of profitability (EBITDA and OFG) per passenger. The unbalance of class 1 is impressive: its OFG per passenger, in absolute value, is larger than OFG per passenger in class 5.

Figure 5.2. EBITDA and OFG per passenger total

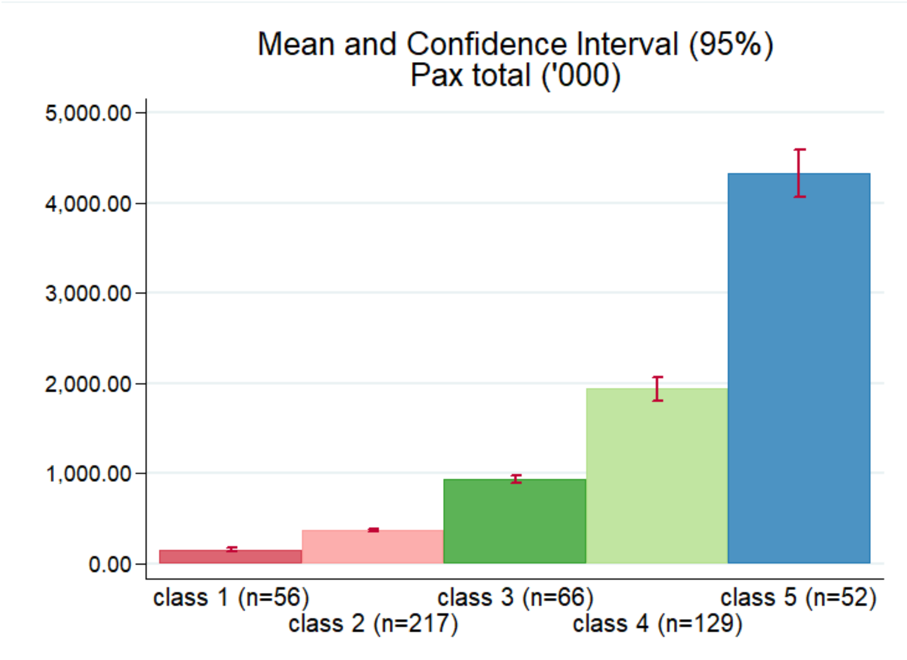


Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines. OFG is the acronym of Operating Funding Gap.*

5.2 PASSENGERS

Average annual passengers across classes are shown in Figure 5.3. The evolution over time of total passengers by class and year is reported in Annex E.

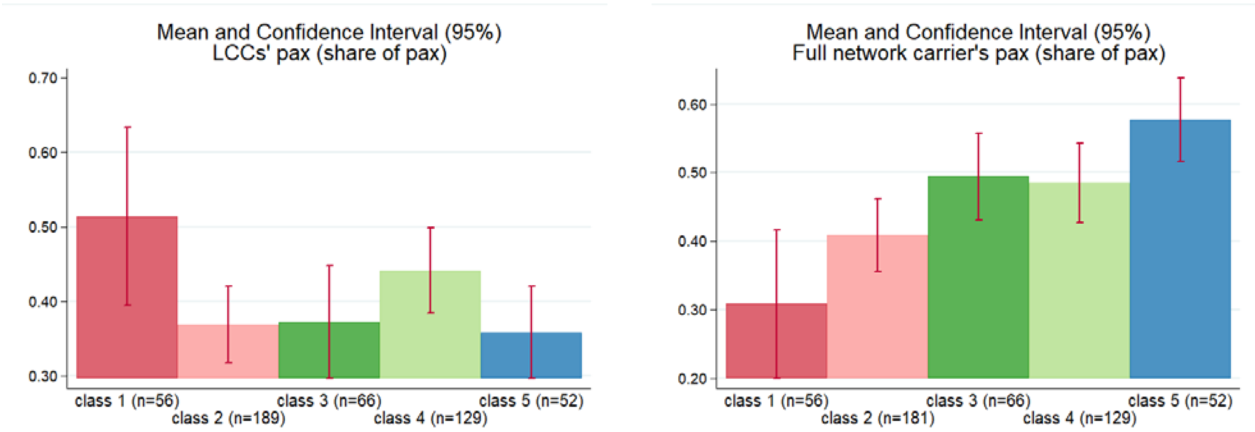
Figure 5.3. Total Passengers

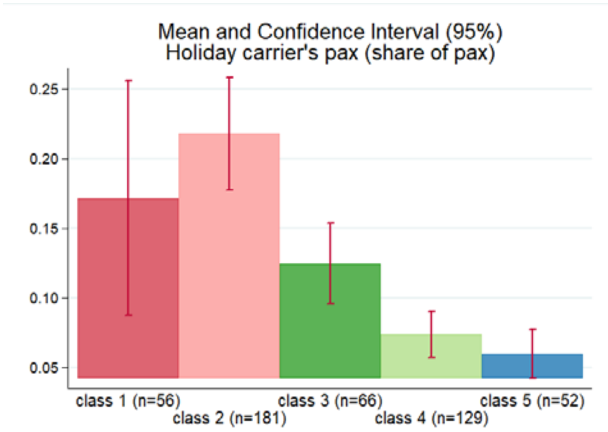


Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

More interesting is to see passenger shares by air carrier type, over different classes, as shown in Figure 5.4.

Figure 5.4. Total Passenger share by air carrier type





Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines. LCCs stands for Low cost carriers.*

The LCCs share of passenger is highest among airports that belong to the first class; noticeably, the fourth class has the second highest share, while the LCCs share is lowest at the top of the distribution of passengers (class 5). The share of passengers coming from Full-Network Carriers ("FNCs") displays a more monotonic pattern in classes, even though the mean is slightly lower in the fourth class than in the third. As to holiday carriers ("HCs"), the shares over classes increase and then decrease with size: the share is high in the first class, reaches its peak in the second class (at more than 20%) and then decreases rapidly for 3rd and 4th class airport. The relative patterns highlight a difference in the mix (there could be also a dynamic substitution pattern, but class in this context is a static attribute and different classes cannot directly indicate a within airports change: airports in different classes may differ mainly also for their location and for other features): traffic at very small airports mainly comes from LCCs; at larger airports, LCCs do not follow proportionally and a greater fraction of traffic comes from HCs and FNCs. However, HCs reach their maximum only in airports in the 200,000-700,000-passenger range.

5.3 OPERATING AID

EBITDA is inflated by public resources paid to airports to fund their operating costs. From an accounting point of view, all public resources placed above EBITDA in the Profit and Loss Statement are deducted from EBITDA to compute the OFG.

Operating aid is only one kind of public resources that airports receive. Table 5.1 shows the number (and %) by class of airports that receive operating aid along the observational period (27% on average). Most airports in the sample receiving operating aid, receive it every year; only 6 out of 18 do not receive operating aid along their entire observational period (2 in class 2; 3 in class 3; and 1 in class 4).

The fraction of airports that receive operating aid in classes 1 and 2 may appear small, considering that these are the airports that face the greatest difficulties in being profitable. Descriptive statistics, as well as all our analysis, are based on data provided by the airports.

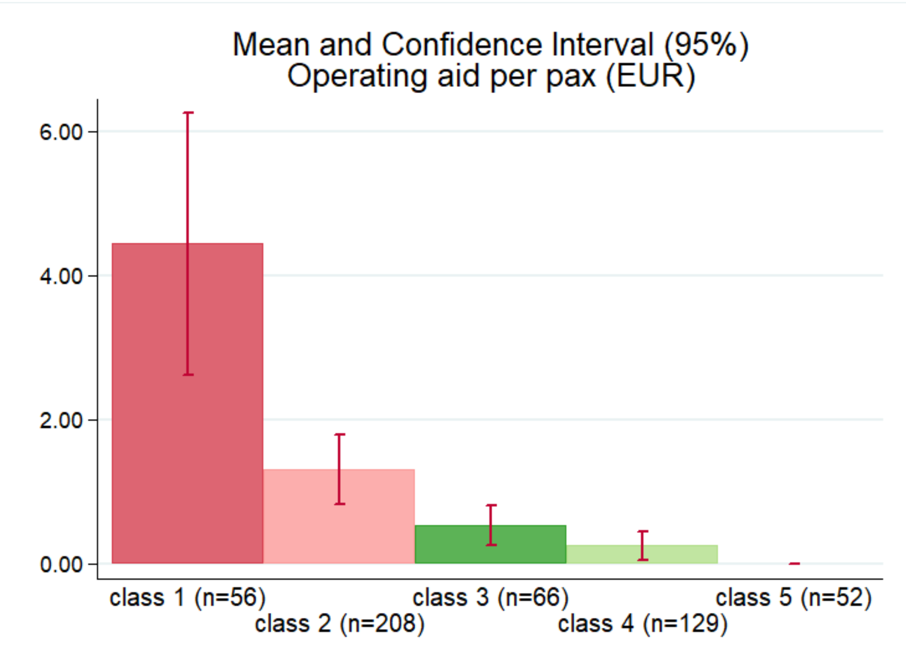
Table 5.1. Number and fraction of airports receiving operating aid ever in the sample

Airports receiving operating aid	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k- 1M]	Class 4 (1M- 3M]	Class 5 > 3M	Total
# of airports	3	7	4	4	--	18
As % of total	37.5%	26.9%	44.4%	23.5%	--	26.9%

Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Unit of measure: "k" stands for thousand; "M" stands for millions

Operating aid received per passenger is monotonically decreasing over classes. Airports in class 1 receive a rate of aid per passenger much higher than airports in all other classes.

Figure 5.5. Amount of operating aid per passenger, by class



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

Airports do not receive only operating aid. They also sometimes receive what they classify as other public resources. In the computation of OFG we are controlling for a definition of operating aid which includes both operating aid and these *unclassified* public resources, which when observed constitute a flow as regular as operating aid. (in Annex E we provide evidence on the overall amount of operating aid plus these unclassified public resources reported by an airport).

5.4 INVESTMENT AID

Capital expenditure is not part of the computation of EBITDA, nor of OFG. So is not investment aid. Table 5.2 shows the number (and %) by class of airports that receive investment aid along the observational period (39% on average).

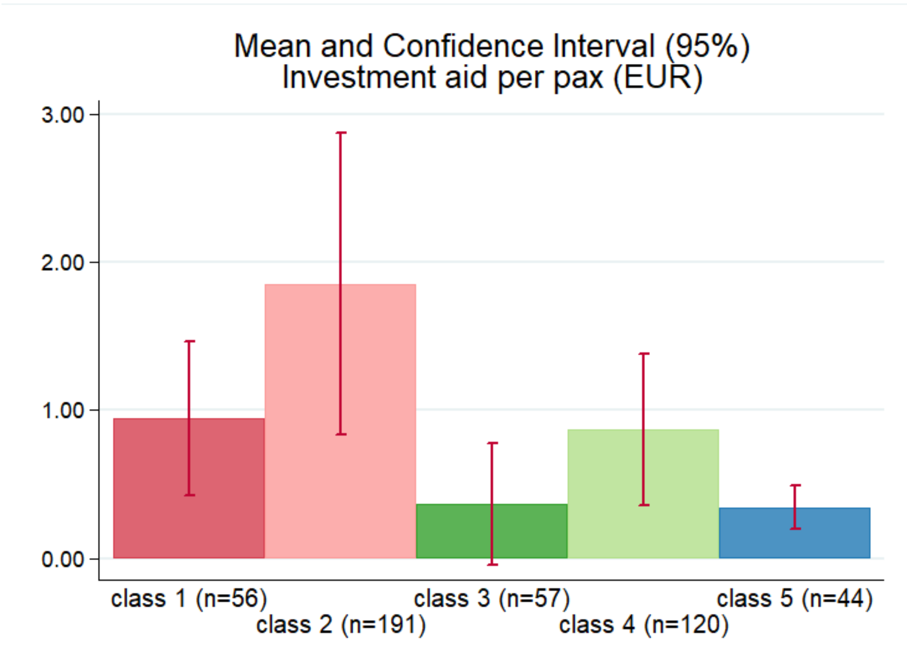
Table 5.2. Number and fraction of airports receiving investment aid ever in the sample

Airports receiving investment aid	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k-1M]	Class 4 (1M- 3M]	Class 5 > 3M	Total
# of airports	4	10	2	5	3	24
As % of total	50.0%	41.7%	25.0%	31.3%	50.0%	38.7%

Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Unit of measure: "k" stands for thousand; "M" stands for millions

In the sample, average investment aid per passenger in class 2 is twice as much the amount recorded in class 1, it has a similar (lower) magnitude in class 3 and 5, while it has a spike in class 4 (which displays a mean close to that of class 1), as shown in Figure 5.6.

Figure 5.6. Amount of investment aid per passenger, by class



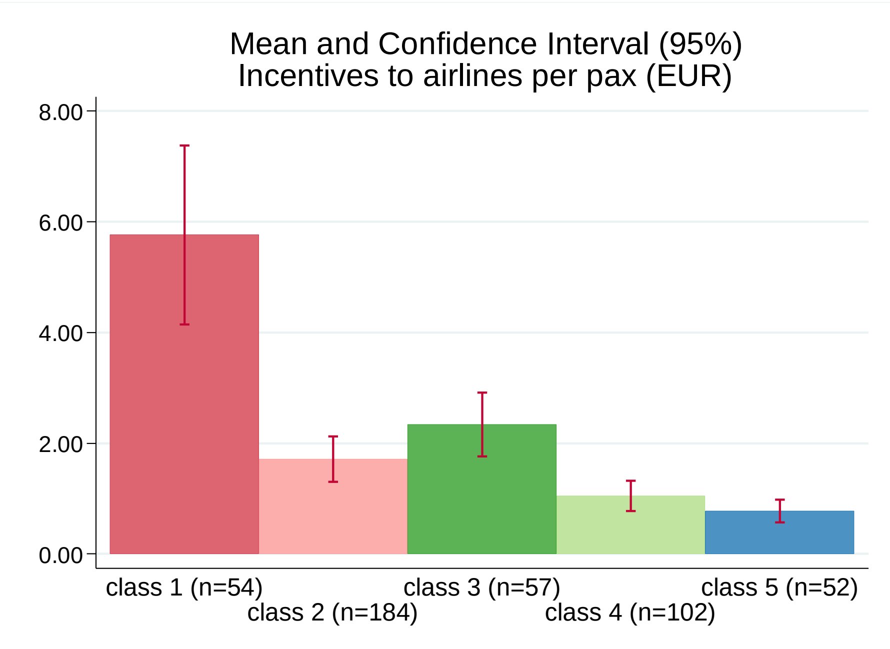
Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

5.5 INCENTIVES TO AIRLINES GRANTED BY AIRPORTS

Data on the total amount of incentives granted to airlines by an airport has been collected from airports. Based on the survey questionnaire, the total amount indicated by airports includes all kinds of incentives: volume discounts, new routes discounts, marketing services and any other type. However, no breakdown is available by type.

Incentives to airlines are consistent with the high share of LCCs traffic observed at small airports. Incentives per passenger are extremely high for class 1 airports, just below 6 euros per passenger (the share of LCCs passengers in class 1 is also the highest). Larger airports pay much less (the second highest rate is paid by class 3, slightly above 2 euros per passenger). This evidence is consistent with the literature concerns about the little negotiation power that small airports have with respect to air carriers.

Figure 5.7. Incentives per passenger by class

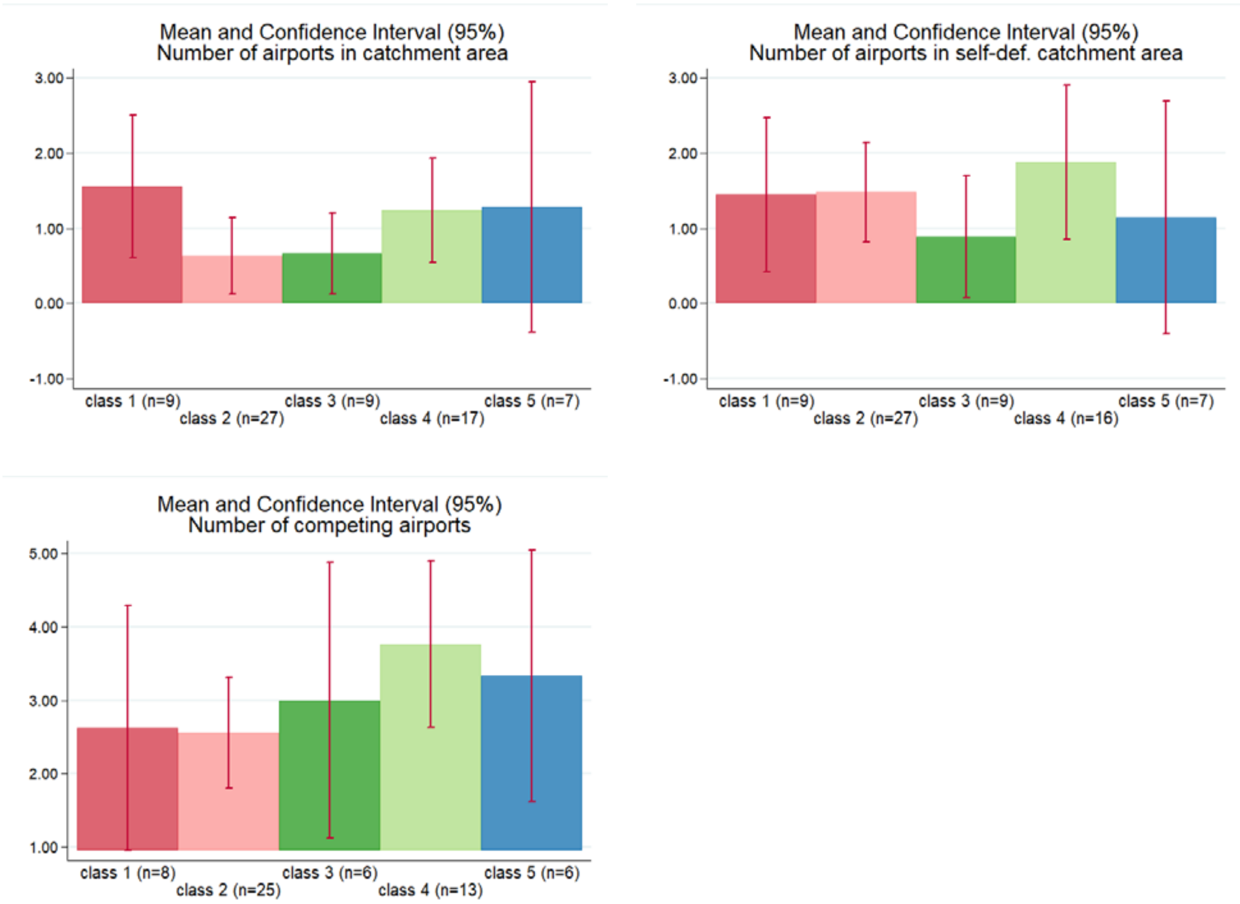


Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

5.6 CATCHMENT AREA AND COMPETITION

There is a difference between the number of airports located in the catchment area (Aviation Guidelines standard definition: around 100 kilometres or around 60 minutes travelling time by car, bus, train or high speed train) and the number of airports located in a catchment area based on surveyed airports' own assessment. The own assessment reflects many factors; the main are geographical characteristics, the density of the population in the area, the density of surface traffic which causes longer travelling times, whether the airports are actual competitors, based on airports' congestion, on the differences in travel destinations served, on existing environmental limits to airport's expansion. On average, the standard catchment area definition tends to underestimate actual competition.

Figure 5.8. Catchment area and competing airports



Source: Team based on sample data. Note: Statistics refer to 2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines (for some classes, the confidence interval in this graph includes the zero because there is a high variability among observations relative to the small number of observations). "Self.def" stands for "self-defined".*

As shown in Figure 5.8, on average, class 1 airports perceive that less airports are in their self-defined catchment area with respect to the standard definition; while for other classes is the opposite. The number of self-perceived competing airports is definitely larger, as competition often extends beyond the catchment area. In class 5 there is a large variation in both the number of airports in the standard catchment area and in the self-defined one. There is a large variability among observations and the number of observations is low (in the survey, only information in 2018 about these variables is provided). As a consequence, there is large uncertainty surrounding the sample's mean, and the confidence interval includes the zero.

5.7 OWNERSHIP

Ownership of airports is a persistent characteristic at the airport level (a low variation is observed in the sample). Public airports dominate the sample (as required in the ToR the minimum quota was set to 70%). Table 5.3 shows that fully owned airports dominate altogether over all classes.

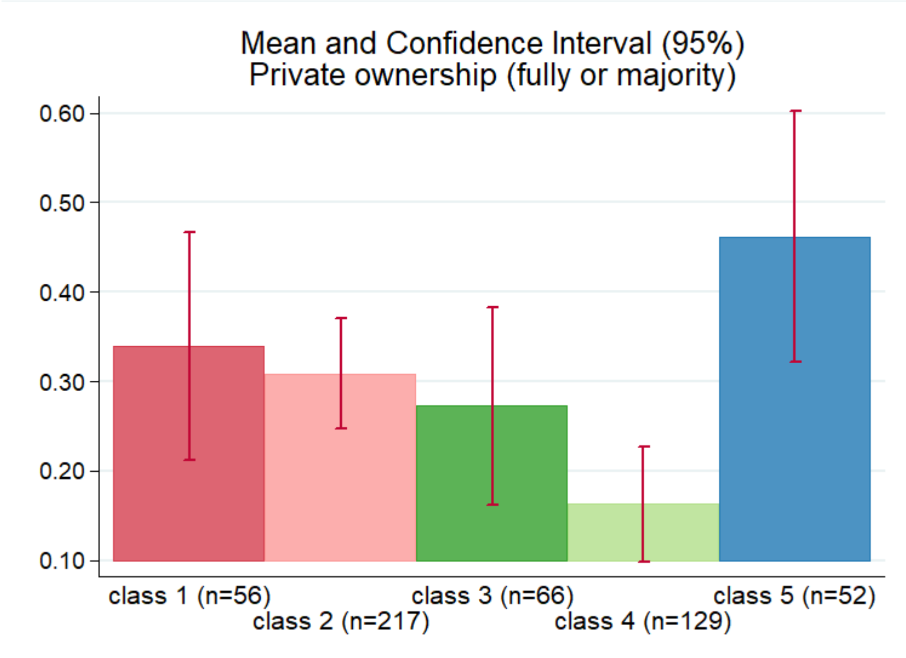
Table 5.3. Number of airports by ownership type

Airport's ownership in 2018	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k- 1M]	Class 4 (1M- 3M]	Class 5 > 3M	Total
FPR	1	8	2	0	2	13
% of class	*12.5%*	*29.6%*	*22.2%*	*0.0%*	*28.6%*	*19.1%*
MPR	2	0	0	3	1	6
% of class	*25.0%*	*0.0%*	*0.0%*	*17.6%*	*14.3%*	*8.8%*
FPU	5	14	5	11	3	38
% of class	*62.5%*	*51.9%*	*55.6%*	*64.7%*	*42.9%*	*55.9%*
MPU	0	5	2	3	1	11
% of class	*0.0%*	*18.5%*	*22.2%*	*17.6%*	*14.3%*	*16.2%*
Total Public	5	19	7	14	4	49
% of class	*62.5%*	*70.4%*	*77.8%*	*82.4%*	*57.1%*	*72.1%*
Total	8	27	9	17	7	68
% of class	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Team based on sample data. Note: Statistics refer to 2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Possible airport's ownership types are: fully private (FPR), mixed ownership with private majority (MPR), fully public (FPU), mixed ownership with public majority (MPU).

Due to sample size constraints, in most of this Study airport's ownership is grouped in two main categories: private and public. Figure 5.9shows the sample mean and confidence interval of the distribution of private ownership (a dummy variable which takes a value of 1 both for fully and majority private airports' observations). The share of private airports is largest in class 5, followed by class 1 and other classes ordered by passenger scale.

Figure 5.9. Private airport's observations in the sample



Source: Team based on sample data. Note: Private ownership is a dummy variable which takes a value of 1 when airports are either fully private or operated under a private majority. Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

6 ASSESSMENT OF THE ADEQUACY OF THE TRANSITIONAL PERIOD

The Aviation Guidelines provide that by the end of the transitional period, i.e. a period of 10 years starting from April 2014, no operating aid to airports from Member States should be allowed.[68] One of the objectives of this Study is to assess whether the transitional period is adequate, in the sense that by the end of this period airports will be able to cover their operating costs with their own resources.

To answer this question, the Team has evaluated past outcomes and prospects of the selected airports. For each airport in the final sample, the OFG has been quantified at the individual airport level, for both past (2010-2018) and future years (2019-2024).[69] The results of the individual assessment have been then used as an input of an aggregate analysis. The aim of the latter is to provide an estimate of the probability of airports to achieve the coverage of operating costs (in expectations) by the end of the transitional period as a function of passenger traffic, which, as acknowledged in the literature and in the Aviation Guidelines, is a key determinant of profitability.

To assess the adequacy of the transitional period and to inform a more robust assessment of self-sustainable operating performance, the Team has introduced complementary approaches to examine the patterns over time of the OFG: the value of the OFG in 2024, the average annual OFG from 2019 to 2024 and the mean change of the OFG over the relevant period. These results have been differentiated across the five passengers' classes retained in the Aviation Guidelines as indicators of heterogeneity in the ability of airports to cover their operating costs.

In addition, evidence is provided regarding whether there is a systematic relationship between individual airport and regional level characteristics available in the data, and the ability of airports to achieve a self-sustainable operating performance by the end of the transitional period. Among airport level characteristics, we consider passenger characteristics (the LCCs share of passengers); whether the airport has received operating and investment aid; variables that capture the business model of airports (incentives granted to airlines, revenue dependence on individual airlines, etc.) and its ownership; the competitive environment (e.g. the number of airports in the catchment area). Region level characteristics (at the NUTS 3 level) are proxies for potential demand in the catchment area (e.g. GDP per capita, population, employment rate). For this analysis we focus on airports of a similar size to better isolate the role of heterogeneity in each of these characteristics.

The final line of evidence provided regards the adequacy of aid intensity permitted during the transitional period relative to airport funding needs over the same time horizon.

The chapter is organised as follows: section 6.1 focuses on the methodology adopted in the assessment and goes through the definition of the OFG (section 6.1.1), as well as the assumptions made to measure it at the airport level and to estimate future airports' performance (6.1.2). Section 6.2 presents the results of the analyses. In particular, section 6.2.1 focuses on the extent to which sample airports will achieve a non-negative OFG by the end of the transitional period;

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[68] "[W]ith the exception of operating aid granted in accordance with horizontal State aid rules, such as rules applicable to the financing of Services of General Economic Interest (SGEI)". Aviation Guidelines, point 129.
[69] The final report will include as an attachment the non-confidential version of the results of this analysis for each airport.

section 6.2.2 looks at the evolution of the average OFG over the period 2010-2024, to assess whether there is a trend towards the equilibrium; section 6.2.3 presents evidence on the different growth potential of airports in different classes; the analysis in section 6.2.4 explores what factors are significantly correlated with the status of airports' OFG in 2024. Finally, section 6.2.5 evaluates the adequacy of aid intensity permitted relative to the funding needs of airports.

6.1 METHODOLOGY

The analysis of the adequacy of the transitional period for the phasing out of operating aid hinges on two main elements:

- the definition of the OFG;
- the assessment of the future profitability of airports, based on past performance and airports expectations.

Accordingly, this section is structured as follows: section 6.1.1 explains how the OFG is calculated; section 6.1.2 goes through the steps and assumptions made by the Team to estimate airports' future revenues and costs.

6.1.1 Definition of OFG

The assessment of the viability of airports depends on the way airports' financial performance is measured. In this section, we rely on the OFG definition retained in the Aviation Guidelines, which is discussed below.

An alternative to OFG definition of airports' profitability has also been studied, by collecting opinions of the airports through the survey questionnaire and during follow -ups calls, as well as through interviews and other exchanges with national associations of airports. These are summarized in Annex B, where we also elaborate on what alternative definition of the airports' funding gap ("AFG") would address common sector's concerns.

According to the Aviation Guidelines, OFG is the shortfall between airport revenues and operating costs, where airport revenues are "the revenues from airport charges net of marketing support or any incentives provided by the airport to the airlines, taking into account revenue stemming from non-aeronautical activities (free of any public support), excluding any public support and compensation for tasks falling within public policy remit, or services of general economic interest" and operating costs are "the underlying costs of an airport in respect of the provision of airport services, including cost categories such as cost of personnel, contracted services, communications, waste, energy, maintenance, rent and administration, but excluding the capital costs, marketing support or any other incentives granted to airlines by the airport, and costs falling within a public policy remit".[70]

The definition proposed by the Commission thus hinges on EBITDA as the starting point to determine the eligible funding needs of an airport concerning operating costs; EBITDA has to be adjusted to neutralise the effect of any public resources received to cover operating costs, and to

[70] Aviation Guidelines point 25(7), (22), (23), emphasis added.

neutralise possible costs borne by an airport to comply with public remit and public service obligations. The computation would be as follows:

$$OFG = [\,EBITDA - Operating\ aid - (SGEI\ and\ public\ remit\ compensations - SGEI\ and\ public\ remit\ costs)\,]$$

Our calculation of the OFG is based on the data collected from airports through the survey questionnaires. Unfortunately, several airports in the sample were not able to provide separately the costs related to SGEI and public remit when relevant (i.e. when they quantified the compensations received for these obligations). Consequently, in many cases it would not be possible to calculate the OFG according to the definition proposed by the Commission. However, by looking at those airports that did provide both information, costs incurred for public remit and SGEI obligations are almost equal to the counterpart compensations (that is, the ratio between the two is on average close to one; and the median equals exactly one, as shown in Annex D).

Thus, throughout our Study, the OFG is calculated under the assumption that the ratio of SGEI and public remit costs to compensations is equal to one for all airports that received this kind of public resources.[71] To summarise, the OFG measure is implemented as follows:

$$OFG = (\,EBITDA - Operating\ aid\,)$$

6.1.2 Assessment of airports' future performance through the definition of alternative scenarios

The assessment of future profitability requires assumptions on future revenues and costs. In the first step, we consider alternative assumptions ("scenarios") for the development of these financial indicators. In particular, for each airport, the following three scenarios have been considered, projecting the EBITDA and the OFG for the 2019-2024 period:

- the "Expected scenario": expected revenues and operating costs ("Opex") are those reported by the airport in the questionnaire;
- the "Last-five-year scenario": revenues, operating costs, cash flow data, depreciation and incentives paid to the airlines are assumed to grow at the average growth rate of the last five years' growth rates observed (2014-2018). Public revenues and the related costs are, instead, assumed to be equal to their Last-five-year' average level since it is not reasonable to assume that public resources follow a growth trend;
- the "Worst scenario": each airport is assumed to be hit by a negative shock in the form of one or more airlines leaving the airport or cutting back on flights in 2019; the impact on revenues of such shock is set equal to the average revenue share of the "top 5 airlines by revenue share"[72]. From 2020 onwards, revenues are assumed to recover at a speed, which depends on

[71] In Annex D, we provide results when relaxing this assumption. This robustness exercise can be performed only for airports that reported both costs and compensations. Its validity for all other airports that for which we do not have data cannot be verified.

[72] Information on the percentage of revenues from passengers of each of the top 5 airlines serving the selected airports was collected through section 1 of the questionnaire.

the last 5-year revenue growth rate:[73] Revenues will initially grow more than the average, but the growth rate will rapidly revert towards the mean. The negative shock on 2019 EBITDA (and EBITDA path thereafter) also depends on how Opex respond to revenues: they will fall by a rate that is derived from the elasticity of Opex to revenues. In particular, the shock on Opex – and therefore EBITDA – depends on the average of the elasticities of Opex to revenues observed whenever revenues declined over the past five years. If revenues never declined over the past five years, but they did farther in the past, the average is calculated over all observations. If revenues never declined over all past observations, we use the absolute minimum elasticity observed over the past.[74]

In the second step, for each airport, the scenario which appeared more consistent with the overall set of available information has been selected ("favourite scenario"). The favourite scenario is used to identify what seems the most reasonable outcome for each airport by the end of the transitional period and, as such, represents the reference for the assessment of the extent to which airports are expected to cover their operating costs by the end of the transitional period.

The selection of the favourite scenario has been based on the qualitative information provided by the airports, or on publicly available sources at country/regional level. When available, statistical data for 2019 (the first two quarters) has been used to indicate which scenario was more in line with, at least in the short run, the current airport performance and business evolution.[75]

As a general criterion, the Expected scenario was not selected as the favourite scenario whenever:

- airports' expectations differed considerably from past years' performance and no supportive evidence was provided by the airport in the questionnaire or could be inferred from general news, the airport website, early statistics for 2019 or other information available (e.g. airport master plan, yearly reports, etc.);[76]

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[73] Defining $t_0 = year\ of\ shock;\ growth\ rate\ in\ year\ t = g_t;\ average\ growth\ rate\ 2014 - 2018 = g$. Then, $g_t = g + g^{t-t_0}$. As t grows, g_t tends towards the past average growth rate g.

[74] The idea is that Opex are less elastic when revenues decline than when revenues grow, especially when the revenue drop is unexpected.

[75] This was, for instance, the case for an airport for which we found news about an event that may affect negatively the business as of 2022, generating uncertainty around the future airport's development. The Team found that the available early statistics for 2019 made airport's own expectations appear too detrimental and, thus, decided to select the Last-five-year scenario as favourite.

[76] As an example, in the case of one airport, passenger traffic was forecast to increase according to the airport's master plan and the submitted questionnaire confirmed an expected increasing path for the volume of passengers for the period 2019-24. However, the reported expected revenues did not show an increasing path, and only operating costs rose with a big jump in 2019 by 44%. The EBITDA was expected to decrease by 133% in 2019, becoming negative in all future sample years, whilst in the past it always displayed positive values. The airport did not provide an adequate rationale behind this switch in performance with respect to its master plan, nor it has been confirmed by our research. Therefore, the Expected scenario was not selected as favourite.

- it presented serious data inconsistencies and it was not coherent with the qualitative information provided in section 1 of the questionnaire.[77]

Anytime two scenarios were both consistent with the past years' performance of an airport and the qualitative information included in the questionnaire on the expected evolution of its business segment, in a more prudent perspective, the less optimistic scenario has been preferred, i.e. the one showing a more contained growth path in terms of magnitude for the main variable of interests.

6.2 RESULTS

Results in this section are organised as follows: in section 6.2.1 the distribution by class of airports that display a non-negative OFG in 2024 in the three different scenarios is discussed. Then, the same results for the favourite scenario are presented. Section 6.2.2 focuses on the evolution of airports' performance over time (past and future). Section 6.2.3 provides evidence of how airports in different classes differ in terms of growth potential. 6.2.4 analyses the heterogeneity of airports in characteristics that can drive performance other than size. Section 6.2.5 presents descriptive evidence on the adequacy of aid intensities permitted under the Aviation Guidelines to meet funding needs of airports over the transitional period.

6.2.1 Distribution by class of airports that will reach the financial equilibrium in 2024 in the different scenarios and identification of the favourite scenario

Table 6.1 below shows the number of airports that display a non-negative OFG in 2024 under each of the three scenarios. The binding constraint for the purposes of this comparison is the existence of an Expected scenario. The Expected scenario is based on forecasts provided by the airports. Contrarily, the other two scenarios are estimated based on past data, which that airports were more willing to provide than expectations for the period 2019-2024. Indeed, the Expected scenario is provided by 52 airports (78% of total).[78] The Last-five-year and Worst scenario were instead computed for all airports.[79] Therefore, Table 6.1 below presents, for each class and in total, the number of airports that are expected to reach the equilibrium in each of the three

[77] As an example, one airport submitted expectations where EBITDA did correspond neither to the difference between operating revenues and costs nor to the projected past EBITDA figures. The expected 2019 EBITDA was 87% lower than the 2018 figure, an even more severe drop than the one estimated in the Worst scenario, notwithstanding a decline in operating expenses of 30%. The EBITDA pattern could in fact be linked to several circumstances reported by the airport in the questionnaire including the crisis of one of the airport's main airlines, large investments in the airport's infrastructure and related repairs and maintenance, as well as an increase of "eage tariffs". To be consistent with the same facts, however, airports' expectations should have also displayed a sharp decline in 2019 revenues, but this was not the case. The Team therefore preferred to select the Worst scenario as favourite.

[78] Note that the Expected scenario was available only if airports provided expectations, at least in the form of expected growth rates per year, for variables that help measure an airport's operating result. Therefore, if an airport provided, for instance, only its expected revenues, it was considered that the Expected scenario was not available.

[79] In one single case, despite the fact that the airport provided expectations about future operating revenues and costs, based on the quality of the information provided it was not possible to compute a reliable measure of the OFG. For this reason, all the results presented in this section do not include this airport that belongs to class 2. The airport was not dropped by the selected sample since the information provided up to the EBITDA was valuable for other analyses.

scenarios, but only for the 52 airports for which the Expected scenario was available, to make figures comparable.

As Table 6.1 shows, the Last-five-year scenario provides a more conservative assessment of airports' outcomes with respect to the Expected scenario, while the Worst-case scenario represents for the vast majority of airports a lower bound of expected performance.

Table 6.1. Distribution by class of airports that will have a non-negative OFG in 2024 under each of the three scenarios (only for airports for which all three scenarios are available)

Class	Number of airports for which all 3 scenarios are available[80]	Expected scenario: number of airports with OFG 2024>0	Last-five-year scenario: number of airports with OFG 2024>0	Worst scenario: number of airports with OFG 2024>0
1	7	5	2	2
2	22	15	14	11
3	6	6	6	5
4	12	12	12	11
5	5	5	5	5
Total	52	43	39	34
%	100%	82.7%	75.0%	65.4%

Source: Team based on sample data.

As explained in section 6.1.2, the most reasonable scenario (favourite scenario) has been identified for each airport among the available options, and the outcome of such assessment is shown in Table 6.2, which presents the frequency with which each of the three scenarios has been chosen as favourite for each class.

[80] This column represents the total number of airports, by class and in total, for which the Expected scenario was available, i.e. airports that provided expectations about future performance.

Table 6.2. Scenarios selected as favourite (in number of airports, % of the total number of airports, number of times the Expected scenario was also available)

Favourite Scenario	Class 1 <200k	Class 2 [200k-700k]	Class 3 (700k-1m]	Class 4 (1m- 3m]	Class 5 > 3m	Total number of airports	Total (%)	Expected scenario available
Expected	3	18	4	10	5	40	59.70%	40
Last-five-years	4	6	5	6	2	23	34.33%	10
Worst	1	2	0	1	0	4	5.97%	2
Total	8	26	9	17	7	67	100.00%	52

Source: Team based on sample data.

As shown in the last column of Table 6.2, among the 52 cases for which the Expected scenario was available, it was chosen as favourite scenario for 40 airports. In the remaining 12 cases that the Expected scenario was an available alternative, ten times the favourite scenario was the Last five years scenario and two times, it was the Worst scenario.

The results presented in the remainder of this section, as well as in the remainder of the Study, are based on the favourite scenario, which is an assessment-based mix of the three scenarios described above.

Table 6.3 shows the distribution by class of the number of airports that are projected to have a non-negative operating funding gap OFG in 2024 according to the favourite scenario. Overall, 54 airports, namely 80.6% of the total number of airports for which it was possible to calculate the expected OFG, will reach "equilibrium" by the end of the transitional period, i.e. their OFG in 2024 is expected to be non-negative. The by class results clearly highlight the stronger financial difficulties faced by smaller airports, confirming the assumptions underlying the Aviation Guidelines' rules for operating State aid. According to our estimation, all airports in classes 3 to 5, i.e. all airports with passenger traffic above 700,000, indeed, are expected to reach the financial equilibrium in 2024, while only 37.5% of class 1 airports and 69.2% of class 2 will be able to reach the equilibrium in 2024 according to our estimation.

Table 6.3. Distribution by class of airports that will have a positive OFG in 2024 in the favourite scenario[81]

Class	Total number of airports	Number of airports in equilibrium	Percent of the class total
1	8	3	37.5%
2	26	18	69.2%
3	9	9	100.0%
4	17	17	100.0%
5	7	7	100.0%
Total	67	54	80.6%

Source: Team based on sample data.

We then investigate how results change across airports depending on their initial financial situation, i.e. among those airports that were already in equilibrium in 2018 and those that were not. We perform this exercise with reference to the situation in 2018 as this is the last year for which there are actual performance data, as opposed to expectations.

First, 51 airports already had a non-negative operating funding gap in 2018, all of which will still be able to cover their operating costs in 2024. It is worth noting that all of the airports belonging to class 3, 4 and 5 (33 in total) were already in equilibrium also in 2018. In addition, 18 airports in classes 1 and 2 were in equilibrium in 2018 and are expected to be so in 2024.

A total of 16 airports were not in equilibrium in 2018, and all belong to classes 1 and 2. Moreover, only 3 among them will be able to cover their costs in 2024: 1 is from class 1 and the others are2 from class 2, as shown in Table 6.4.

[81] Note that, following the Aviation Guidelines definition, a positive operating funding gap means that the airport generates enough revenues, net of public aid, to cover its operating costs.

Table 6.4. Distribution by class of airports that will have a positive OFG in 2024 among those that had a negative OFG in 2018 (in units)

Class	Total number of airports in the class	Number of airports that were not in equilibrium in 2018	Number of airports in equilibrium in 2024 among those that were not in equilibrium in 2018	Number of airports in equilibrium in 2024 as % of those that were not in equilibrium in 2018
1	8	6	1	16.7%
2	26	10	2	20.0%
Total	34	16	3	18.8%

Source: Team based on sample data.

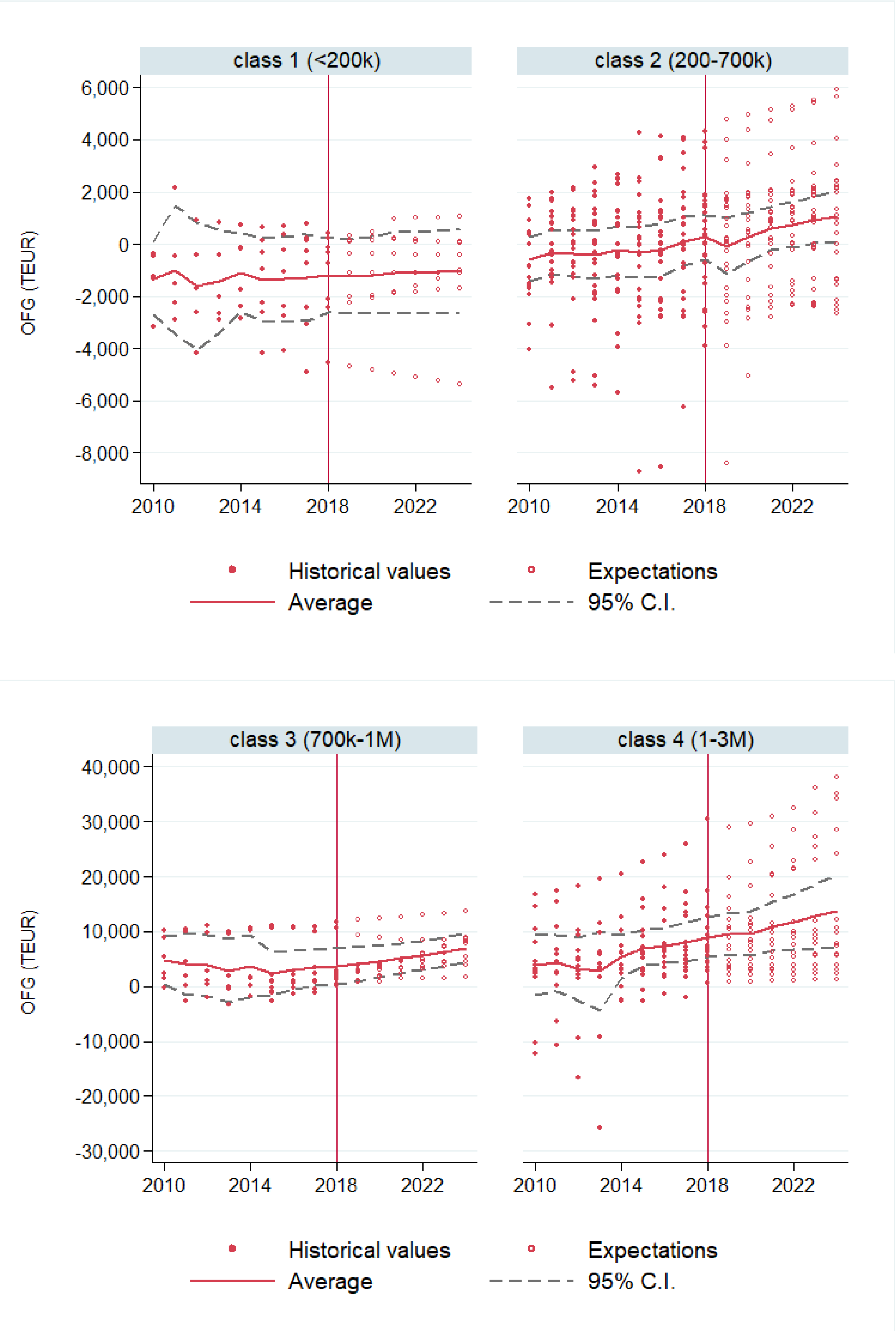
This pattern denotes a deep persistency in airports' outcomes: among the 16 airports that were not in equilibrium in 2018, 81% (13 out of 16) are also expected not to be in equilibrium in 2024, while only 19% will recover. Persistency also works the other way around: all those who were in equilibrium in 2018 are expected to still be so in 2024.

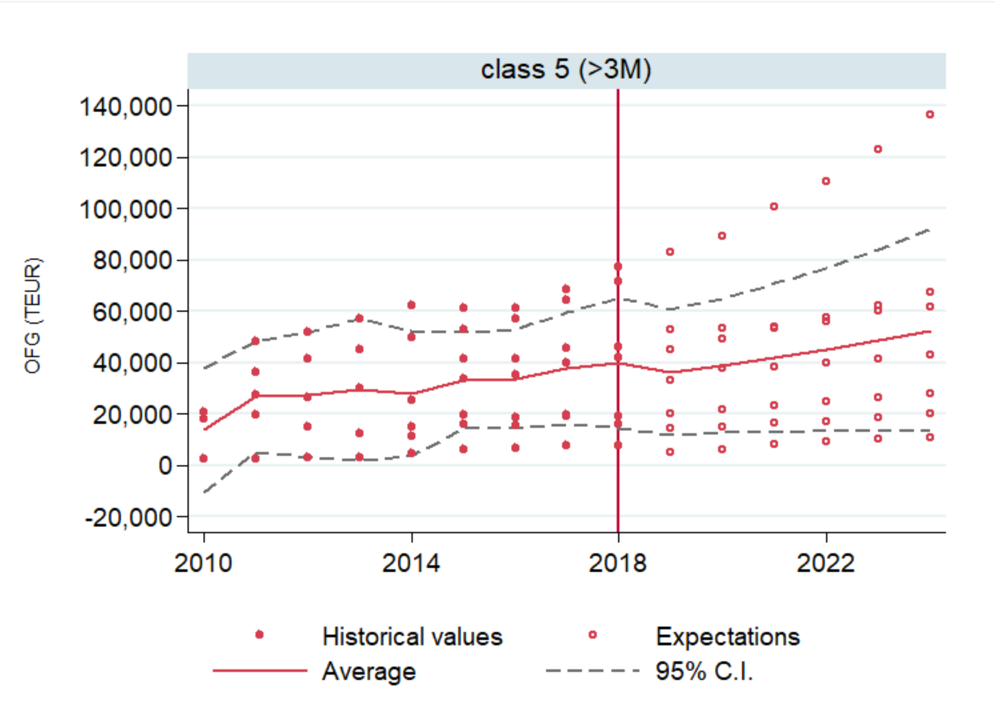
6.2.2 Evolution over time of past and expected performance

In order to assess the adequacy of the transitional period, it is necessary to look at the evolution over time of the OFG, going beyond its expected level in 2024. It might indeed be the case that even airports that were in equilibrium in 2018 and are expected to be in equilibrium in 2024 as well, are on a negative path, thus revealing reasons for concern about the adequacy of the transitional period.

Figure 6.1 below shows the mean value of the average OFG for each class over the period 2010-2024; it also shows for each year in the past, the values of the OFG for each airport, as well as the projections in the future based on the favourite scenario. While the mean OFG for bigger airports exhibits a positive trend, in class 1 the average performance is negative with no sign of significant improvement.

Figure 6.1. Operating funding gap by class





Source: Team based on sample data. Note: Airports' data for 2010-2018 (historical values: solid red circles) and 2019-2024 (expectations: hollow red circles). The average is the red solid line. The 95% confidence interval is indicated by the two dashed black lines. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). Class boundaries are reported in parentheses above each graph. "k" is a shortcut for thousands; "M" for millions; "TEUR" for thousands of Euros.

These graphs corroborate the evidence presented in section 6.2.1 that airports with passenger traffic above 700,000 (classes 3 to 5) are on a good path: projected OFG values are above zero in all cases and exhibit a positive trend on average. There is a difference, though, between airports in classes 3 and 4 with respect to class 5 airports. Some airports in classes 3 and 4 had a negative OFG in the past up to 2018 and show a steadily positive OFG only in expectations. Instead, all class 5 airports had a steadily positive OFG already in the past.

Airports in class 1 and 2, instead, are less financially viable, with projected OFG being negative for each year of the period 2019-24 for some of them. In particular, for class 1 airports this pattern seems to be more persistent. Class 2 airports at least on average display a positive trend, even though at the individual level the patterns seem more mixed.

In addition, it is worth then considering whether results presented in section 6.2.1 differ if one looks at the cumulative OFG from 2019 to 2024, instead of just considering the value of the OFG in 2024. Our analysis shows that results do not change overall: for each class, the same total number of airports is in equilibrium.[82] However, in class 2 there is a change in the composition: where two airports switch in opposite directions: one is non-negative in 2024 but the cumulative OFG is *still* negative (in fact this airport is improving its performance in the period); the other one

[82] We cumulate the net present value of the OFG from 2019 to 2024. Net present value is computed using the weighted average cost of capital (WACC) for the air transports industry, $WACC_{2018} = 7.30\%$, estimated by the IATA and reported in the *IATA Annual review 2019* (page 8).

is negative in 2024 but its cumulative OFG is *still* positive (in fact the airport's performance is deteriorating during the period). This is reported in columns 2 and 3 of Table 6.5, that splits the sample based on the baseline results from section 6.2.1 (reported in column 1 for comparability): in Panel A, airports that have a non-negative OFG in 2024; in Panel B, airports that have a negative OFG in 2024; Panel C, all airports. Table 6.5 shows the average annual OFG from 2019 to 2024 for each group and class.

Finally, the number of airports whose expected OFG improves over the period 2019-24 has been evaluated. An airport could have a negative OFG in 2024 (or a negative cumulative OFG) but be improving (or the opposite way around). This aspect is especially important to assess whether it may be useful to prolong the transitional period for operating aid. The results of this analysis are presented in column 4 of Table 6.5. They can be compared to the baseline results from section 6.2.1 (first column).

In Panel A of Table 6.5, the total number of airports with OFG improving in the period 2019-24 is lower than the number of airports in equilibrium and, in particular, there are airports with passenger traffic above 700,000 that do not satisfy this criterion. Panel A of Table 6.5 also displays, for each class, the average cumulative OFG and the annual percentage change of the OFG between 2019 and 2024. These figures suggest that, whilst it is true that in class 3 and 4 there are, respectively, one and three airports whose OFG is expected to deteriorate between 2019 and 2024, the average cumulative OFG for airports belonging to these classes is well above zero on average and increasing over the years for airports belonging to these classes.

From Panel B of Table 6.5, looking at airports that have a negative OFG in 2024 (and a negative cumulative OFG over the entire period), we can say that 54% (7 out of 13) are slightly improving their performance with respect to 2019 (by 5.7% on average), and that the main contribution to the average improvement comes from class 2.

Table 6.5. Supplementary statistics on OFG in the years 2019-24

Class	Total number of airports	Number of airports with positive average OFG (2019-24)	Average OFG (2019-24) (Net present value '000)	Number of airports that improve OFG (2019-2024)	Average OFG change 2024 vs. 2019 (%)
PANEL A – Airports with OFG 2024 > 0					
1	3	3	276.9	1	22.5%
2	18	17	1,330.6	16	19.8%
3	9	9	4,175.2	8	15.0%
4	17	17	8,803.8	14	8.9%
5	7	7	34,058.6	7	9.0%
Subtotal	54	53	8,341.3	46	9.9%
PANEL B – Airports with OFG 2024 < 0					
1	5	0	-1,588.8	3	1.6%
2	8	1	-1,604.9	4	7.5%
3	-	-	-		
4	-	-	-		
5	-	-	-		
Subtotal	13	1	-1598.7	7	5.7%
PANEL C – All Airports					
1	8	3	-889.2	4	2.9%
2	26	18	427.3	20	332.1%
3	9	9	4,175.2	8	15.0%
4	17	17	8,803.8	14	8.9%
5	7	7	34,058.6	7	9.0%
Total	67	54	6,412.7	53	11.1%

Source: Team based on sample data.

6.2.3 Evidence on growth potential

Airports in class 1 and 2 exhibit a structural weakness. In class 1 the average OFG from 2019 to 2024 is negative (positive OFGs do not offset the negative ones). Airports in class 2 are all on a more positive trend. This is better shown by looking at Figure 6.2 and Figure 6.3 that display separately airports in classes 1 and 2 with a negative OFG in 2024, from those with a positive one.

There are two points worth making: airports in class 1 do not exhibit any growth pattern independently on the OFG balance in 2024; individual airports in class 2 that have a negative OFG also do not look on a steady recovery path: however, the mean OFG is improving, recovering from a drop in 2019, even though the pattern of individual data points is quite mixed.

Figure 6.2. Airports in class 1 and 2 with a negative OFG in 2024

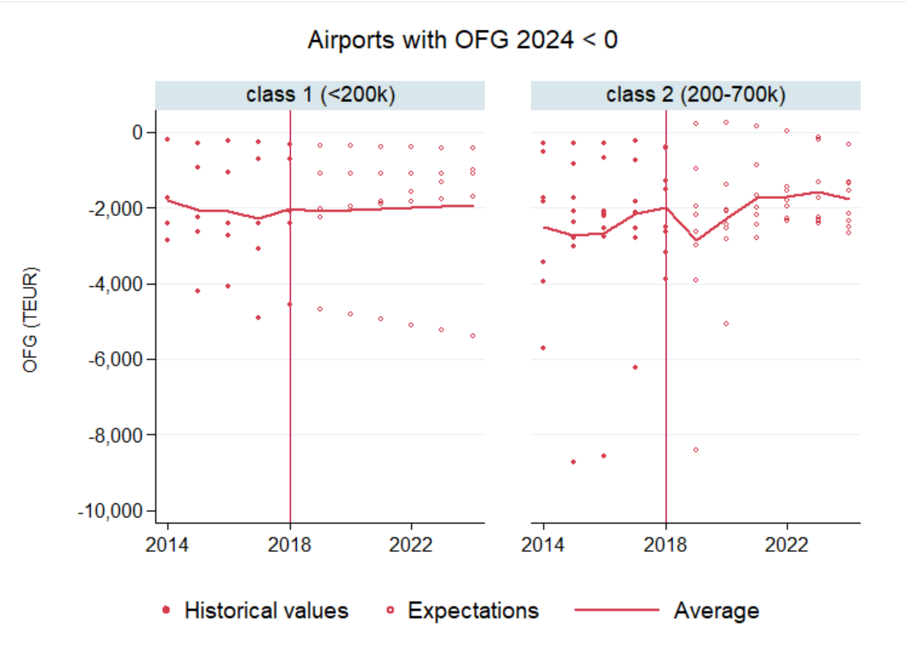
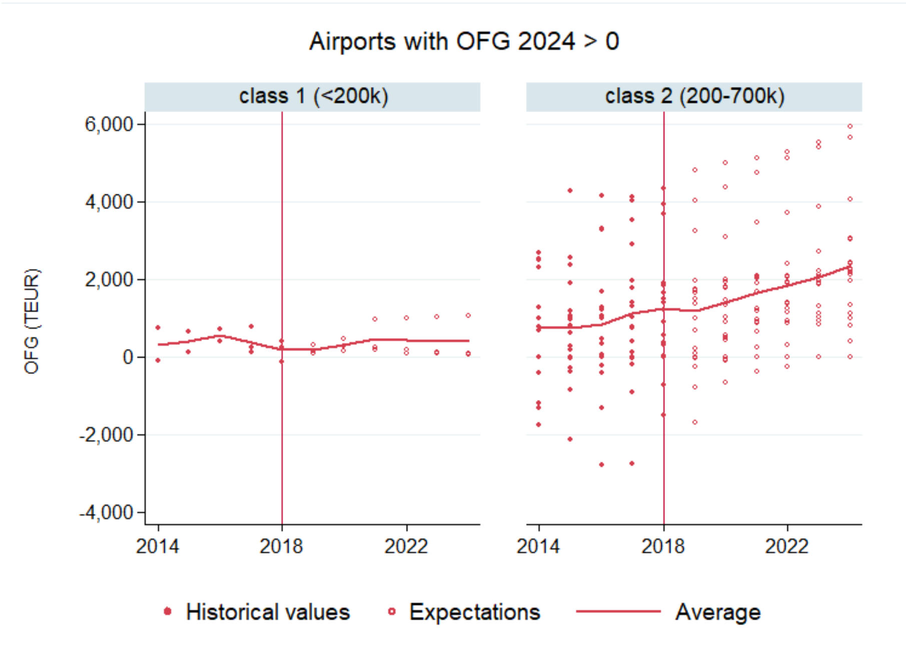


Figure 6.3. Airports in class 1 and 2 with a positive OFG in 2024



Source: Team based on sample data. Note: Airports' data for 2010-2018 (historical values: solid red circles) and 2019-2024 (expectations: hollow red circles). The average is the red solid line. Airports are grouped into 5 classes based on passengers (in thousands(k): class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "TEUR" is a shortcut for thousands of Euros.

From the literature presented in section 3.2, we understand that small airports suffer because of economies of scale. Evidence on airports' potential financial growth should be assessed together with airports' ability to increase their scale. Furthermore, as it will be shown in the next sections, passengers are one of the key drivers of an airport's profitability. In addition, we collected evidence from Eurostat on passenger traffic evolution for all EU airports since the late 1990s, to further comment on this point. And it shows two key facts: (i) the patterns we find in our sample are similar to all EU airports when divided into classes using the same criteria (average passengers between 2014 and 2017); (ii) airports below 700k tend to stay at their scale even after many years of activity; even if their passenger traffic grows since entry, they never scale up above their class boundary, while all airports above 700,000 do on average. Graphs are reported in Annex E. In conclusions, small airports are not able to attain a larger size over time, and this may contribute to their inability to improve their operating performance.

6.2.4 Drivers of airports' viability in classes 1 and 2

As shown in the previous sections, the only airports that are not expected to be able to cover their operating costs by the end of the transitional period belong to class 1 and 2.

Therefore, the statistical analyses presented in this section focus exclusively on these two classes and try to identify drivers that explain why some airports in these classes will be in equilibrium in 2014, while others will not.

While the class to which an airport belongs to (reflecting the number of passengers) is clearly considered a factor that may affect its viability, we investigate whether there are other drivers of an airport's ability to reach the financial equilibrium, *i.e.* whether there exist other factors that are systematically associated with the ability of airports to cover their costs by 2024.

Airports belonging to smaller passenger classes are the most fragile: airports that do not achieve equilibrium are found only in class 1 and in class 2, though there is heterogeneity among them. The evidence in section 6.2.1 would indeed suggest that the transitional period would not be sufficient to make airports in class 1 financially viable; whilst the majority of airports in class 2 will reach equilibrium and airports in this class show, at least on average, improving trends. By investigating which factors are most likely to positively affect the profitability of smaller airports, the Team aims at identifying which additional factors, together with passengers' traffic, may be used to better estimate the financial needs of these airports and tailor accordingly the intensity of the aid to be granted.

The question is whether the group of airports that will be in equilibrium in 2024 and the group of airports that will not reach equilibrium, significantly differ in the following factors:

- operating and investment aid received: whether any aid was received in the period 2010-18 and the intensity of such aid relative to the airport's passenger traffic are potential factors that might drive airports' ability to cover their costs;
- ownership structure is investigated by testing whether there exists a statistically significant difference in the proportion of airports with a private majority or fully private versus airports with a public majority of fully public ownership. In the selected sample, there were only six airports with mixed ownership in classes 1 and 2;

- fraction of passengers coming from LCCs over total passengers; the composition of passengers could be an important determinant of profitability, because of the business model of LCCs;
- incentives paid to airlines: airports often grant incentives to airlines in the form of volume or new route discounts or marketing services. The airports that are included in our sample were asked to report whether they have made any of such payments in the period 2014-18 and to quantify such payments for the whole period 2010-18; we test both the total amount of incentives and the amount per passenger, granted in a given year;
- revenue concentration: it is indeed reasonable to assume that airports whose revenues are concentrated among a few airlines might be more financially fragile. It was thus tested whether the revenue share of the top airline for each airport, i.e. the one with the largest revenue share, significantly differs among the two groups of airports;
- share of non-aviation revenues over total operating revenues; the industry consensus is that this is a key indicator of profitability (*ceteris paribus*, increasing the share of non-aviation revenues is expected to increase profitability);
- adoption of measures aimed at improving operating results in the years 2014-18, including changes in the airport's business model, variation to the airports' charges, development of commercial activities or the implementation of cost-efficiency plans;
- if an airport reports congestion problem over the years 2014-18 (on the one hand congestion is a problem as it can cause delays and lower safety levels, on the other hand congested airports operate at full capacity and fixed costs are fully exploited);
- shocks suffered: it was explored whether a shock in the form of one or more airlines having left or having cut back on flights from/to the airport in the years 2014-18 is a relevant driver of airports' viability;
- number of airports in the catchment area, as defined by the Aviation Guidelines, and number of competing airports, as declared by airports;
- characteristics of the NUTS 3 region where the airport is located: the NUTS 3 region is a proxy for the characteristics of an airport's catchment area.[83] Airports' profitability is indeed affected by socio-economic and demographic factors. Therefore, macroeconomic factors such as GDP per capita, population, employment rate and total freight transported may affect their likelihood to reach financial equilibrium by the end of the transitional period.

Table 6.6 below shows the results of the t-tests on the differences in means of the abovementioned drivers. The drivers tested are reported in the first column. The second and third column present the means, for each driver, for the group of airports that are expected to have, respectively, a negative and positive OFG in 2024. The fourth column represent the difference between the two means and is to be interpreted as follows: a positive difference implies that the

[83] NUTS 3 region are defined accordingly to the Eurostat classification (as explained in section 4.2).

driver is negatively associated with airports' ability to cover their operating costs.[84] Finally, the last column indicates the statistical significance of such difference at three conventional thresholds.

[84] Some of the drivers analysed are continuous variables, others are instead dichotomic variables, i.e. variables that take value 1 at the occurrence of a certain event and zero otherwise. In the case of such dichotomic variables, the means can be interpreted as the proportions of airports, in each group, for which the event occurred.

Table 6.6. Focus on classes 1 and 2: comparison of means of variables in airports with a negative OFG in 2024 vs. airports with a non-negative OFG in 2024

Variables	Means		Difference in means (Mean comparison t-tests)	
	OFG<0 in 2024 (a)	OFG>0 in 2024 (b)	(a – b)	Statistical significance
Aid				
Operating aid per pax [EUR]	3.56	0.98	2.58	***
Operating aid granted [0/1]	0.54	0.14	0.40	**
Investment aid per pax [EUR]	2.73	1.00	1.73	**
Investment aid granted [0/1]	0.42	0.45	-0.03	
Business model/ownership situation				
Private airport [0/1]	0.19	0.41	-0.22	***
Fraction of LCC pax	0.56	0.28	0.28	***
Incentives to airlines [TEUR]	881.99	651.57	230.42	*
Incentives to airlines per pax [EUR]	4.38	1.70	2.68	***
Top1 airline's share of revenues in 2018	0.63	0.50	0.13	
Fraction of non-aviation revenues	0.25	0.22	0.03	**
Improving measures in 2014-2018 [0/1]	0.38	0.67	-0.28	
Congestion in 2014-2018 [0/1]	0.00	0.29	-0.29	**
Shock suffered in 2014-2018 [0/1]	0.73	0.65	0.08	
Competitive environment				
# of airports in catchment area in 2018	0.31	1.14	-0.84	*
# of competing airports in 2018	2.82	2.45	0.37	
Local economic conditions				
GDP in PPS per inhabitant	28,408.34	27,177.34	1,231.01	
Population ['000]	675.79	804.37	-128.57	
Employment rate	0.44	0.38	0.05	***
Total transported goods by region of unloading ['000 t]	14,248.69	17,527.73	-3,279.03	*
N of airports	**13**	**21**		

*Source: Team based on sample data. Only airports in classes 1 and 2 are considered. For all the drivers, the period 2010-18 has been considered unless otherwise specified. Please note that for time invariant variables (Top1 airline's share of pax revenues in 2018, # of airports in catchment area in 2018, # of competing airports in 2018) only values in 2018 are known and used to perform mean-comparison tests. Units of measure in square brackets: [TEUR] stands for thousands of Euros; ['000 t] stands for thousand tons, [0/1] indicates a dummy variable. The number of stars in the last column indicates the level of statistical significance resulting from t-tests: * (p<0.10), ** (p<0.05), *** (p<0.01).*

For some drivers, the statistical significance of the difference is low due to the small size of the sample. Indeed, after restricting the focus on class 1 and class 2 airports only, there remain 34 airports out of which 21 are expected to reach the equilibrium and the remaining 13 are expected not to. However, while including also class 3, 4 and 5 airports could have increased the statistical significance of tests, it could have entailed the risk of attributing a statistical difference between profitable and unprofitable airports to the wrong reason. If bigger airports, indeed, intrinsically differ from smaller airports in the factors explored as potential drivers, this could have biased the tests' results. Below we interpret the results of our analysis, by focusing on the statistically significant differences.

Airports that received operating aid seem to be less likely to reach the equilibrium in 2024: indeed, the proportion of airports that received operating aid is higher (54%) in the group of airports that will not reach the equilibrium than in the group of airports that will (14%), and this difference is significant at the 5% level. Consistently, the average amount of operating aid received per passenger is larger for the group of airports that will not reach equilibrium in 2024 and this difference is statistically significant at the 1% level. In addition, the average amount of public aid per passenger received to support investment is larger for the group of unprofitable airports (2.7 EUR vs. 1.0 EUR) and this difference is statistically significant at the 5% level. All results regarding variables that measure public funding might be interpreted as driven by reverse causality, since the airports that received aid might have been those with the most critical financial situation. Yet, the amount of aid received might have been insufficient to help them recover from an adverse financial performance.

Having a private ownership[85] is instead positively associated with being able to reach the financial equilibrium: the proportion of private airports in the group of airports that will have a positive OFG in 2024 is indeed larger (41% vs. 19%) and this difference is significant at the 1% level.

Airports that are expected not to reach the equilibrium in 2024 have a larger share (56% vs. 28%) of passengers from low-cost carriers and this difference is significant at the 1% level. Small airports often have a low bargaining power and a business model strongly dependent on low-cost traffic is unlikely to allow them to reach the financial equilibrium. This is consistent with the result that airports that are expected to be unable to cover their operating costs in 2024 grant to airlines, on average, a larger amount of incentives per passenger (4.4 EUR vs. 1.7 EUR) and this difference is significant at the 1% level.

Airports that are expected to be unable to cover their costs in 2024 display, on average, a larger share of non-aviation revenues with a significance level of 5%, though the difference in magnitude is small (25% vs. 22%).

Airports that suffered from congestion problems are more likely to be able to cover their operating costs with a significance level of 5%. As suggested above, *ceteris paribus*, congested airports may obtain significant cost advantages due to the larger scale of operations.

The average number of other airports in the catchment area is lower (and less than one) for airports that are expected not to reach equilibrium in 2024. The difference is significant at the 10% level. The economic literature is controversial on the effect proximity to other airports on an

[85] Both fully private airports and airports with mixed ownership with a private majority were counted.

airport's performance: results support the view that proximity encourages competition and, hence, spurs efficiency (see section 3.2.2). The mere fact that there is more than one airport in an area, in addition, may suggest that in that area demand for air transport is higher, making it easier for airports to attract passengers (this interpretation is also consistent with results regarding reported congestion).

Results regarding the attractiveness of regions where airports are located are mixed. Those airports that are not expected to reach the equilibrium are located, on average, in regions characterised by a slightly higher employment rate (this difference is significant at the 1% level). This result is counterintuitive. However, their regions attract a lower amount of annual road freight (significant at the 10% level). The results of the means comparison for NUTS 3 statistics must be taken with caution. The definition and especially the size of the NUTS 3 regions, in fact, vary across countries and results may be driven by the differences in the definition.

6.2.5 Evaluation of aid intensity

As already explained, since 2017, airports up to 200,000 passengers can benefit from the GBER and can receive operating aid that covers up to 100% of their operating losses both before and beyond 2024.[86]

All other airports are subject to the Aviation Guidelines rules. Under the Aviation Guidelines, the maximum amount of operating aid that an airport can receive annually, during the transitional period of ten years, is determined ex-ante as the product of two elements: a maximum aid intensity permitted, and the average initial OFG of the airport.

As to the first element, as explained in section 2, different maximum aid intensities are permitted, based on airports' passenger traffic. Passenger traffic is used as a proxy for the need of aid, where smaller airports are granted greater aid intensity. The aid intensity regimes are the following:

- a special aid intensity of 80% is featured for airports up to 700,000 passengers;
- the standard maximum aid intensity is 50% for airports above 700,000 passengers;
- airports with more than 3 million passengers cannot receive any operating aid.

The second element needed to determine ex-ante the maximum amount of aid permitted, is the average initial OFG of an airport, based on the five years prior to the start of the transitional period.

In order to evaluate the adequacy of the operating aid intensity established in the Aviation Guidelines, we can compare the maximum amount of aid that airports could virtually receive over the transitional period (aid entitlement) to their actual OFG during the same period

We can compute the aid entitlement only for airports that show an ex-ante need of aid, i.e. a negative average initial OFG. The average initial OFG should be computed over the period 2009-

[86] Certain compatibility conditions must be met (see Commission Regulation (EU) 2017/1084 of 14 June 2017).

2013 (to be a five-year average), but our sample starts in 2010 and some airports only provided data for a shorter period. Since we have yearly data from 2010 to 2024, we define the ten-year transitional period to extend from 2015 to 2024.[87]For airports joining the sample in 2010, we use the period 2010-2014 to calculate the initial OFG; for airports that join the sample later, we use a shorter period. By using this approximation, the analysis can be performed independently on the year an airport joins the sample.[88]

In the analysis, the actual OFG during the transitional period coincides with the OFG computed using historical data from 2015 to 2018 and projections of the OFG up to 2024 under the favourite scenario.

The evidence on airports above 200,000 passengers per year (class 1) is that 5 out of 8 (62.5%) have a negative initial OFG (columns 2-3 of Table 6.7); all 5 airports also exhibit a negative OFG during the transitional period (column 4). This is not surprising, as these airports are the same that in 2024 are still expected to have a negative OFG (see results in section 6.2.1). Under the GBER, aid can cover up to 100% of operating losses and is not subject to a ceiling based on ex-ante OFG (i.e. “maximum aid” is not defined in the meaning of the Aviation Guidelines rules; that is why the corresponding cell in column 5 of Table 6.7 does not show any number). However, it is interesting to know that only 1 airport in this group has an average OFG during the transitional period greater than its annual average initial OFG.

[87] The actual transitional period began on 4 April 2014 (Aviation Guidelines, point 134).
[88] The only exception is one airport for which we could not compute OFG as the data on public funding was not complete. The same airport is excluded from all analyses based on OFG.

Table 6.7. Evaluation of aid intensity established in the Aviation Guidelines for airports with initial OFG<0 and total OFG 2015-2024<0

Max aid intensity permitted	All airports in the sample	Number of airports with initial OFG < 0	As % of all airports	Number of airports with initial OFG < 0 & OFG < 0	Number of airports where max aid is less than OFG	As % of all airports	As % of airports with initial OFG<0
100% (Class 1)	8	5	62.5%	5	n.d.	--	--
80% (Class 2)	26	13	50.0%	9	6	23.1%	46.2%
50% (Class 3)	9	3	33.3%	0	--		
50% (Class 4)	17	2	11.8%	0	--		
0% (Class 5)	7	0	0.0%	--	--		
Total	67	23	34.3%	14	--	--	--

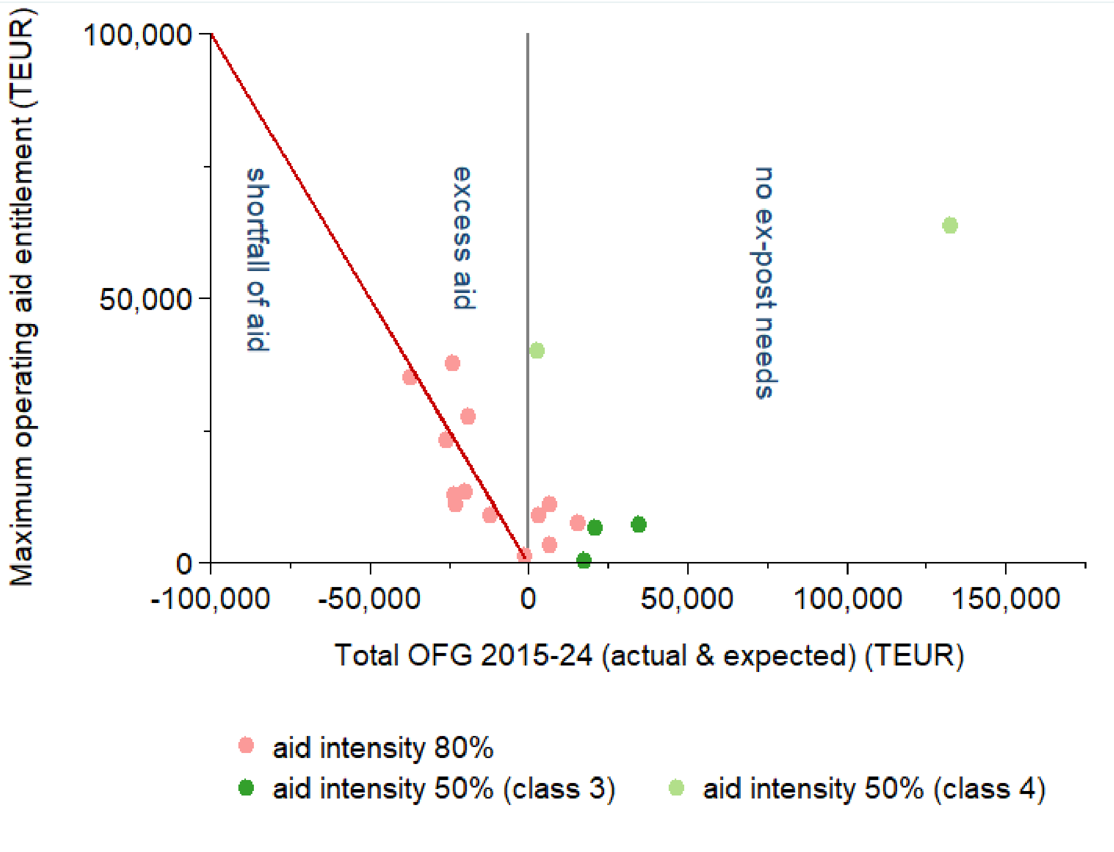
Source: Team based on sample data. Note: Initial OFG is the (ex-ante) Operating Funding Gap computed over the period 2010-2014. Instead, OFG is the (ex-post) Operating Funding Gap of airports during the transitional period (2015-2024). Maximum aid entitlement is determined based on initial OFG.

As to airports above 200,000 passengers per year, Table 6.7 shows that:

- none of the airports above 3 million passengers (class 5) has a negative initial OFG (thus their need of aid as proxied by the initial OFG is zero); moreover, their exclusion from access to operating aid seems in line with their needs, as captured also by the OFG based on both realized (2015-18) and projected values (for the period 2019-24); this is in line with our previous findings;
- 18 airports are found to have a negative initial OFG:
    - for 9 of these, the average (and total) OFG during the transitional period is found to be positive (the initial operating losses were thus temporary); 5 of these would be entitled to the 50% aid intensity regime (split between class 3 and 4), while 4 belong to those entitled to the enhanced aid intensity of 80% (class 2);
    - the remaining 9 airports have both a negative initial OFG and a total OFG 2015-2024 lower than zero and are all entitled to the 80% aid intensity (class 2). For these

airports we can check whether permitted operating aid intensity would be such to cover the funding needs that emerge over the transitional period, partly based on forecasts. As reported in the last column of Table 6.7, there are 6 cases where airports are expected to develop an average OFG greater than what aid intensity allows to cover. Annex B provides also a more detailed view of the size of these airports in terms of passenger within the class's range definition.

Figure 6.4. Maximum amount of aid permissible and actual total OFG during the transitional period, in airports with negative initial OFG. Only airports above 200,000 passengers.



Source: Team based on sample data. Unit of measure: TEUR stands for thousand Euros.

Figure 6.4 show for each of the 18 airports with a negative initial OFG the two pairs: on the y-axis, the maximum amount of operating aid to which these airports are entitled given aid intensity thresholds; on the x-axis, the total OFG these airports are expected to record during the transitional period. Total OFG during the transitional period can be either positive or negative. In the plot region:

- the 9 airports that have a positive OFG during the transitional period are on the right-hand side of the black vertical line; these are those that do not show need of operating aid during the transitional period;
- on the left-hand side of the black vertical line and to the right of the red bisector line there are the 3 airports that have a negative total OFG during the transitional period but the maximum aid they can receive would be enough to cover it;

- last, on the left-hand side of the red bisector line there are the 6 airports for which operating aid entitlement is insufficient to cover needs.

For the last two groups Figure 6.4 also shows the distance between aid entitlement and aid needs.

All 6 cases where aid intensity is less than ex-post aid needs are in the category of airports below 700,000 passengers, where aid intensity level is already high at 80%. The 6 airports represent 23% of those falling in the 80% level of aid intensity or 46% of those showing a negative initial OFG (where a negative initial OFG represents ex-ante funding needs). In both cases, results show that aid intensity seems to be enough for the majority of airports. In our conclusions, we suggest considering that the aid intensity seems not to be adequate for 23% of airports (rather than 46%) for the following reasons. First, the number of airports on which the evaluation is based is small. Second, the airports for which aid intensity appears not sufficient are also those (except one) that do not reach equilibrium in 2024. It could be misleading to judge the suitability of aid intensities based on the failure to entirely cover the funding needs of airports that may not have the potential to improve their performance. Moreover, evidence of ex-ante funding needs is not exogenous in this context, as we can only identify it through an airport's past negative performance; and there is a risk of evaluating aid intensity against worst performers. To address this possible bias, we retain the more conservative approach of assessing the number of cases where a given aid intensity could fail against the entire group of airports that are exposed to that aid intensity (rather than looking only at airports showing ex-ante funding needs).

6.3 CONCLUSIONS ON THE ADEQUACY OF THE TRANSITIONAL PERIOD

According to the Aviation Guidelines, in 2024 State aid to airports for operating costs will phase out, as the transitional period established in 2014 to allow airports gradually adjust toward a self-sustainable operating performance, will end. One of the objectives of this Study is to evaluate whether the transitional period is adequate, based on evidence of the extent to which airports will be able to cover their operating costs, investigating whether outcomes differ depending on the level of passenger traffic or on other factors.

In this section, based on the final sample of airports, we have performed the following analysis:

- we have assessed how many airports will reach the financial equilibrium in 2024 and differentiated findings by airports' classes. We have also evaluated whether airports that did not reach equilibrium in 2018 (last year for which we have actual data as opposed to expectations), will be able to do it in the near future;
- we have assessed the average operating funding gap of the airports over the next five years (2019-2024), and again, differentiated findings by airports' class;
- we have investigated the evolution of the operating funding gap, for each airport's class, between 2019 and 2024, to elicit improvement prospects;
- we have verified whether airports that are not able to cover their operating costs by 2024 differ systematically in observables from other airports that are similar in size;
- we have evaluated, when possible, whether aid intensities established in the Aviation Guidelines are appropriate to provide support to the airports.

The main conclusions we may draw are as follows:

- Larger size airports seem to be healthy. Evidence in section 6.2.1 shows that, based on expectations, airports in class 3, 4 and 5 will be able to fully cover their operating costs in 2024. Class 5 airports show the best performance as OFG is always positive both in the past and in expectations. Some airports in class 3 and 4 had a negative OFG in the period 2010-2018 but all have a steadily positive OFG in expectations, between 2019-2024. Focusing on the latter, that fall in the perimeter of operating aid, also the few in classes 3 and 4 that still had a negative operating funding gap in 2018 are expected to fully recover in 2024. In classes 3 and 4 there are a few airports that, individually, display a net negative change in the OFG between 2019 and 2024 (one in class 3 and three in class 4) indicating that even if their OFG is expected to be positive in 2024, it less so with respect to 2019. However, the class average OFG over the entire period is largely positive. Moreover, also the class average change in the OFG over the entire period is positive (between 15% of class 3 and 8.9% of class 4). Furthermore, the positive trend in financial performance of these airports should be assessed together with the evolution of passengers. Both when looking at sample data and at Eurostat data for all EU airports, classes 3, 4 (and 5) display a larger growth potential than smaller classes. Especially Eurostat data suggest that airports in these classes tend to scale up above class boundaries. On the one hand, this may have contributed to the overall positive trends in their operating funding gap. On the other hand, the presence of few airports in class 3 and 4 showing a declining trend (although an overall positive OFG) should not raise concerns regarding the ability of airports belonging to these classes to self-sustain their operating activities.
- Smaller size airports seem more fragile. Airports belonging to class 2 are for a large majority (69%) able to achieve the equilibrium by 2024. In addition, both those expected to be and not to be in equilibrium in 2024 exhibit, on average, improving trends especially relative to 2019. However, the recovery path of the few class 2 airports that are expected to have a negative OFG in 2024 does not look steady on a yearly basis: they recovered, on average, from a significant drop in 2019, but it is not possible to predict whether these airports will be able to achieve a positive OFG at some point; second, when looking at individual patterns, the evidence is also mixed: on the one side it seems that there is no expectation of large negative OFGs as in the past; on the other side, still 4 of them (i.e. 50% of the ones that will not reach equilibrium) expects a deterioration relative to 2019. However, looking at the class performance altogether, the average OFG in 2019-2024 is positive and substantially improving over the same period; and, at the individual level, most airports (20 out 26) expect an improvement. Concluding on class 2 airports, while the results may suggest a limited failure of the transitional period for allowing all class 2 airports to reach the equilibrium, it could be that the few that are expected to be far from equilibrium in 2024 represent an exception in their class and do not have the potential to become profitable.
- Airports belonging to class 1 are expected to be mostly (63% of the sample) unable to achieve the equilibrium by 2024 and they show mostly declining profitability trends (both those that are in equilibrium in 2024 and those that are not). None of the class 1 airports that have received operating aid is expected to reach financial equilibrium in 2024. The collected evidence on class 1 airports seems to point towards the existence of a ‘permanent’ weakness. Eurostat data on passengers for all EU airports shows that class 1 airports, on average, hardly

grow above 200,000 passengers over time, and their performance during the period 2010-2018 has been quite flat. For class 2 airports hitting the 700,000-passenger cut-off is also a rare event.

- The literature also maintains that small airports are weaker and may need support forever to survive. In an industry characterized by increasing returns to scale, small airports are intrinsically less efficient. Small airports also heavily rely on few airlines, attracted through costly incentives. We provided evidence from the existing literature that in the past few years LCCs diverted from secondary to primary airports (see section 3.2.6). This trend may negatively affect the financial viability of the smaller airports that leverage LCCs for most of their turnover. Even though no clear-cut definition of small airports and of a minimum efficient scale can be elicited from the literature, certainly, in our sample, class 1 airports exhibit the emphasised weaknesses: they pay, on average, a much higher rate per passenger of incentives to airlines than all other classes; have, on average, more concentrated revenues over the main airlines and have the highest average share of LCCs passengers. This business model does not seem to bring in signs of improvement nor to be sustainable, based on the evolution of their OFG. In addition, the same kind of weaknesses that the literature emphasises, characterise as a whole the group of airports that are expected not to reach equilibrium in 2024: this group, which includes both class 1 and class 2 airports, has a significantly higher dependence on passengers from LCCs and a higher rate of incentives per passenger paid to airlines, on average, as compared to the airports that do reach equilibrium in the same classes (and the differences are statistically significant).

- Results support the idea that there are structural factors that impede the financial growth of the smaller airports that are not expected to be able to be financially viable by 2024 either in class 1 or in class 2, while the operating aid logic is temporary and exceptional. As to class 1 airports, this matter is no longer much relevant, as the Commission, in 2017, has extended the General Block Exemption Regulation to operating aid granted to airports below 200,000 annual passenger traffic. This implies that as long as the compatibility conditions are satisfied, since 2017 class 1 airports can receive operating aid up to 100% of their operating losses before and beyond 2024. It remains an open question though as to the few class 2 airports that do not expect to reach equilibrium by 2024.

- To address funding needs of a permanent, rather than temporary nature, more structural measures of public support would be more appropriate and the decision to support airports facing prolonged difficulties to (at least on average) cover their operating costs should follow from a rationale different from profitability alone, as in the case of:

    - regional aid, which has the rationale of enabling the benefits of greater connectivity of remote regions; of creating spill-overs on economic activity and, consequently, on employment, as supported by some evidence in the regional development literature;

    - aid contingent on extraordinary situations: small airports are fragile and exposed to shocks due to the high revenue concentration; recent extreme events like airlines bankruptcies (e.g. in Germany) hit some of the small airports in the sample, up to 75% of their revenues; the feature of this type of aid should be to grant a timely intervention in very well defined extreme events, and well-designed to provide the right incentives.

Finally, the analysis of aid intensity has shown that:

- in the aid intensity regime of 80%, permitted for airports below 700,000 passengers and above 200,000 (i.e. class 2 airports), aid intensity seems to be enough for the majority of airports: in fact, a total of 6 airports are expected to have a total OFG over the transitional period that exceeds the maximum amount of operating aid they could receive; and the 6 airports represent 23% of their range of aid intensity or 46% of those showing a negative initial OFG in that range (i.e. ex-ante funding needs). Since ex-ante funding needs are not exogenous, we retain the more conservative approach of considering that the aid intensity would not allow to cover ex-post funding needs for 23% of airports that fall in this range. In fact, these are also the airports that do not reach equilibrium by 2024 and basing the assessment on their performance could be misleading (these airports may not be able to achieve equilibrium even over a longer time horizon);

- the adequacy of aid intensity could not be assessed for airports below 200,000 passengers per year, as under GBER rules they can be subsidised up to 100% of their operating losses (also beyond the transitional period); nonetheless, the analysis has shown that only 1 airport (12.5% in its group) has an average negative OFG during the transitional period greater than its annual average initial OFG; this implies that only 12.5% of class 1 airports would be constrained by a ceiling of operating aid based on ex-ante needs (proxied by initial OFG), at least in the case of an aid intensity of 100%;

- we could not either directly assess the adequacy of the standard regime of aid intensity of 50% because all airports falling in this range completely recover over the transitional period from their negative initial OFG; however, one could say that as such aid intensity did not constrain any of them;

- none of the airports above 3 million passengers has a negative initial OFG. Thus, their exclusion from operating aid seems adequate.

The objective of operating aid is to let airports that are able to become profitable over a reasonable time horizon to do so, and so be ready to the phasing out of operating aid. For those that do not show a clear-cut improvement along the transitional period, one may conclude that they do not have the potential to become profitable, because they face different, structural problems. As a consequence, we cannot conclude that the transitional period was not adequate (or that aid intensity was not adequate); as it could also be the case that other measures of a more structural nature may work (or have worked) better.

7 ASSESSMENT OF THE ADEQUACY OF AIRPORTS CATEGORISATION FOR OPERATING AID RULES

The Aviation Guidelines establish a categorisation of airports defining the maximum permissible operating aid amount during the whole transitional period according to the following rules:

- 80% of the initial OFG, for airports with annual passengers traffic up to 700,000 passengers;[89]
- 50% of the initial OFG, for airports with annual passengers' traffic between 700,001 and 3 million of passengers;
- airports exceeding 3 million passengers are not eligible for operating aid.

The identification of such thresholds is aimed at ensuring that the operating aid is proportionate and limited to the minimum necessary for the aided activity to take place. Moreover, as already discussed in the previous sections, in 2017, the Commission extended the GBER to operating aid to airports up to 200,000 passengers. Under the new formulation of Article 56a of the GBER, under certain conditions, operating aid to these airports is compatible with trade and competition within the EU internal market, and its intensity can extend up to 100% of operating losses plus a reasonable profit, both before and beyond 2024.[90] Overall, the existing provisions as of today set forth a variation of operating aid intensity at 3 passenger cut-off's (200,000; 700,000; 3,000,000), which results into 4 different aid intensity regimes.

The available data at the time of the drafting of the Aviation Guidelines established a link between airports' financial situation and their traffic levels. In particular, the Aviation Guidelines indicate that airports handling fewer than 700,000 passengers per year may not be able to cover their operating costs to a large or substantial extent, while airports up to 1 million and up to 3 million passenger should, respectively, be able to cover a greater share or the majority of their operating costs. Airports with annual traffic above 3 million passengers are usually profitable and thus excluded from access to operating aid.

Moreover, when dealing with investment aid, the Aviation Guidelines outline that airports handling less than 1 million passengers per annum typically struggle to cover their capital costs, while airports with traffic level up to 3 million passengers should be able to cover their capital costs to a greater extent; however, there is an acknowledgment that even airports with traffic level between 3 and 5 million passengers per year may fail to cover all their costs (including both their operating and capital costs) and, in very exceptional circumstances, may require public support to support some of their capital costs. Airports handling over 5 million passengers per annum should instead be able to reach profitability.

In this section, the Team provides an assessment of whether passengers' thresholds set forth in the Aviation Guidelines to establish the need for operating aid remain fit for the purpose. This encompasses two complementary questions:

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[89] See footnote 14.
[90] Commission Regulation (EU) 2017/1084, point (5).

- whether the number of passengers is relevant and sufficient to establish the need of operating aid. This question is relevant as the definition of the operating aid intensity could indeed be based on additional (or alternative) factors, such as the characteristic of the catchment area of the airport, which may better represent the financial situation of the airport; [91]
- whether the thresholds in the Aviation Guidelines are appropriate or whether a different categorization should be adopted. This question goes more to the hearth of the *ex post* assessment exercise, *i.e.* the suitability of the airports' categorization in the Aviation Guidelines. The Team assesses whether these thresholds are suitable to identify airports' need for financial aid. This also includes verifying whether the rule, according to which airports with more than 3 million passengers per annum are not entitled to receive operating aid, is appropriate.

Even though operating aid intensity currently varies at the thresholds of 200,000, 700,000 and 3 million passengers, the Aviation Guidelines acknowledge that there is evidence of heterogeneity of operating aid need also at the cut-off of 1 million of annual passenger traffic. Therefore, the analysis in this chapter focuses on the finer five-size classes categorisation of airports that guided sample selection, to disentangle possible variation in the relationship between airports' profitability and passengers.[92]

7.1 METHODOLOGY

To answer the two complementary questions discussed above, we use a two-step approach. In the first step, we use simple univariate descriptive and statistical techniques to assess the relationship between the classes, *i.e.* the thresholds that capture the potential ability of airports to cover operating costs, and the airport profitability as measured by OFG.[93] Specifically, we investigate whether the thresholds based on passengers set out in the Aviation Guidelines to define the five-classes are well defined to explain airports' profitability and their ability to be financially viable. Moreover, we explore whether other factors, besides the number of passengers, help explaining the airports' profitability within the defined classes. In a second step, we use multivariate regressions to more precisely assess the role of passengers for profitability,

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[91] Indeed, using a sample of 125 airports for the period 2010-2016 (Zuidberg, 2017) shows that, while the total number of passengers does not affect profitability the share of transfer passengers, seasonality, capital cost efficiencies, regional economic development and population play a more important role. See Zuidberg, J. (2017). Exploring the determinants for airport profitability: Traffic characteristics, low-cost carriers, seasonality and cost efficiency. Transportation Research Part A, 61–72.

[92] As explained in section 4.1.1, the categorization of sample airports into one out of the five size groups has been set at the time of the sample selection, based on Eurostat data on airports' annual traffic between 2014 and 2017. Each sample airport is set to belong to a given group if, based on such data, it mostly stays in this group between 2014 and 2017. Thus, a class is a time invariant attribute of each sample airport.

[93] We conducted several robustness checks using different measures of profitability, namely EBIDTA and EBIT Adjusted (EBIT–Subsidies –depreciation) as well as OFG per passenger, EBITA per passengers, and EBIT adjusted per passengers. While each measure lead to slightly different quantitative results, the qualitative findings and the main message of the analysis are not affected.

by controlling for the other factors identified to be relevant drivers of profitability and allowing for heterogeneity in this relationship.

7.1.1 Clustering

In the first part of the chapter, we rely on a cluster analysis[94] to verify whether the classification based on passengers, *i.e.* the classes defined in the Aviation Guidelines, is correctly matching airports financial viability. The analysis introduced in this section is composed of two key steps.

In the first step, we use a profitability measure –the average OFG defined over the years 2015-2018– to classify airports within homogenous groups (clusters) of airports. This allows us to classify airports strictly based on their profitability.[95]

In the second step, we investigate the characteristics of airports within the different clusters and classes to identify what factors influence profitability under which circumstances. In particular, for each class of airports separately, we compare the characteristics of airports classified in different profitability clusters. The underlying reasoning is that significant differences among variables between these groups could suggest what factors are a relevant driver of profitability for the different types of airports. In our investigation, we mostly focus on the determinants of profitability put forward in the existing literature (see section 3). These include, for instance, the number of passengers, nature and role of traffic, ownership and organisation, or competition variables.

Clustering analysis allows us to identify characteristics (other than the number of passengers alone) that can also plan an important role for profitability. However, it does not allow assessing whether these factors are correlated and which of them is more important once we control for the others. Consequently, regression analysis is needed to better capture the relationship between passengers and profitability.

7.1.2 Regression analysis

In the second step of our methodology, we introduce a multivariate econometric approach to examine the relationship between passengers as well as other factors and airports' profitability within one model. This multivariate approach is important to control for the potential correlation among the different factors and, thus, conducting *ceteris paribus* analyses that identify the contribution of each factor to airports' financial performance.

[94] Cluster analysis is a statistical technique, which aims to classify observations in a set of homogenous groups. The Study uses partition-clustering methods, where means are used to create partitions.

[95] In the reported analysis, we focus on the average OFG over 4 years since it is a clearer measure for the mid-run profitability of an airport. This choice lead to one observation for each airport, which makes the classification easier. As a robustness check, we performed the entire analysis also using yearly measures of OFG (leading to 4 observations for each airport) and results are equivalent.

Specifically, we analyse the relationship between the airport *i*'s financial performance in time t (π_{it})[96] and the airports' traffic level ($Pass_{it}$), other control factors x_{it} that have been determined to be relevant in establishing the categorization of airports through the cluster analysis,[97] as well as airports fixed-effects (ω_i) and time trends (ω_t):[98]

$$\pi_{it} = \alpha_0 + \alpha_1 Pass_{it} + \alpha_2 x_{it} + \omega_i + \omega_t + \epsilon_{it}. \quad (1)$$

The results of this simple model help to assess (i) whether the traffic level significantly affects the airports' financial situation, (ii) whether there are other factors that, in addition to the traffic level, affects the airports' financial situation *ceteris paribus*, and (iii) whether such other factors contributes to the airports' financial performance to a greater extent than the traffic level.

This simple model is then extended to evaluate the heterogeneity of the link between an airport's financial situation and its traffic level across different traffic levels. Thus, the enriched model allows the relationship between covariates and profitability to vary according to the classes *c*, as defined in the Aviation Guidelines:[99]

$$\pi_{ict} = \beta_{0c} + \beta_{1c} Pass_{ict} + \beta_{2c} x_{ict} + \omega_i + \omega_{ct} + \epsilon_{ict}. \quad (2)$$

This additional step – which essentially consists of estimating model (1) separately for each of the five classes – should help better assessing the adequacy of passengers' thresholds provided by the Aviation Guidelines. However, it is most demanding in terms of the quality of data received from airports' responses to questionnaires.

Finally, the model is further enriched to allow the relationship between passengers and profitability to vary with the other factors that have been identified to be relevant for the airports' financial viability. Because this model is very demanding in terms of data, instead than estimating the model separately for the different classes, we estimate it using interactions:

$$\pi_{ict} = \beta_{0c} + \beta_{1c} Pass_{it} + \beta_{2c} Pass_{it} \times x_{ict} + \beta_{3c} x_{it} + \omega_i + \omega_{ct} + \epsilon_{ict}$$

To estimate this model, we rely on the data collected through the survey, covering the years 2010-2018 for each of the selected airports. Questions on the profitability measures as well as control factors are in fact part of the questionnaires that have been distributed to airports in the selected sample. Moreover, the Team relies on additional publicly available data on the socio-economic, infrastructural, and demographic characteristics of the airports' catchment area, which

[96]We use different measures of profitability such as EBITDA, OFG, ratios of revenues, EBITDA and OFG to passengers and revenues. Since the main findings are robust independently of the used outcome variable, we focus our discussion on the most relevant indicator: EBITDA.

[97]These include incentives to airlines, operating aid, investment aid.

[98]Notice that, by using airport fixed-effects, we are not able to identify the impact of time invariant characteristics such as number of competitors and ownership structure on profitability.

[99] The classes are defined as follows: $c = 1\ if\ Pass_{it} \leq 200{,}000$; $c = 2\ if\ 200{,}001 \leq Pass_{it} \leq 700{,}000$; $c = 3\ if\ 700{,}001 \leq Pass_{it} \leq 1{,}000{,}000$; $c = 4\ if\ 1{,}000{,}001 \leq Pass_{it} \leq 3{,}000{,}000$; and $c = 1\ if\ Pass_{it} \geq 3{,}000{,}001$.

are based on regional statistics by NUTS 3 classification provided by Eurostat. We refer the reader to section 5 for a detailed description of the data.

7.2 RESULTS

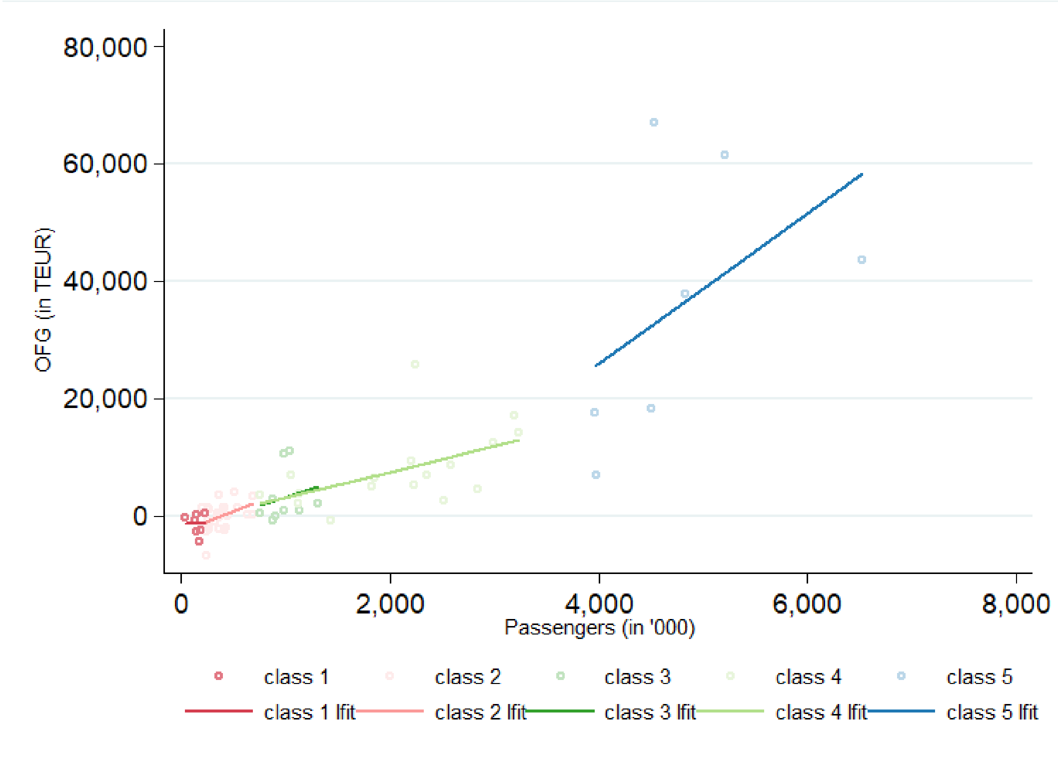
7.2.1 Introduction

The focus of the analysis is the identification of key drivers of airports' profitability, and, in particular, whether the number of passengers is **relevant** and **sufficient** to establish the need of operating aid. Before looking at the results of the statistical analyses, we provide few descriptive representations of the relationship between traffic and financial performance. In this section, we focus on OFG as the main profitability measure.[100]

Figure 7.1 represents the relationship between the average OFG over the period 2015-2018 (in TEUR) and the average number of passengers (in '000) over the same period.[101] Thus, each dot represents an airport. By using different colours, the figure distinguishes between the five classes of airports identified in the Aviation Guidelines. Finally, the figure also reports the linear fit by class representing this relationship.

[100] In Annex C we report the same analysis based on two alternative measures of profitability: (i) an alternative definition of an airport's funding gap (AFG), inclusive of costs of capital non-eligible for investment aid, which can be considered a relevant alternative measure of profitability as discussed in Annex B; (ii) EBIT-adjusted, *i.e.* EBIT minus operating aid received by an airport.
[101] In Annex C we report the same analysis based on predicted OFG, average over the period 2019-2024.

Figure 7.1. Relationship between OFG (in TEUR) and Passengers (in thousands), average values over the years 2015-2018



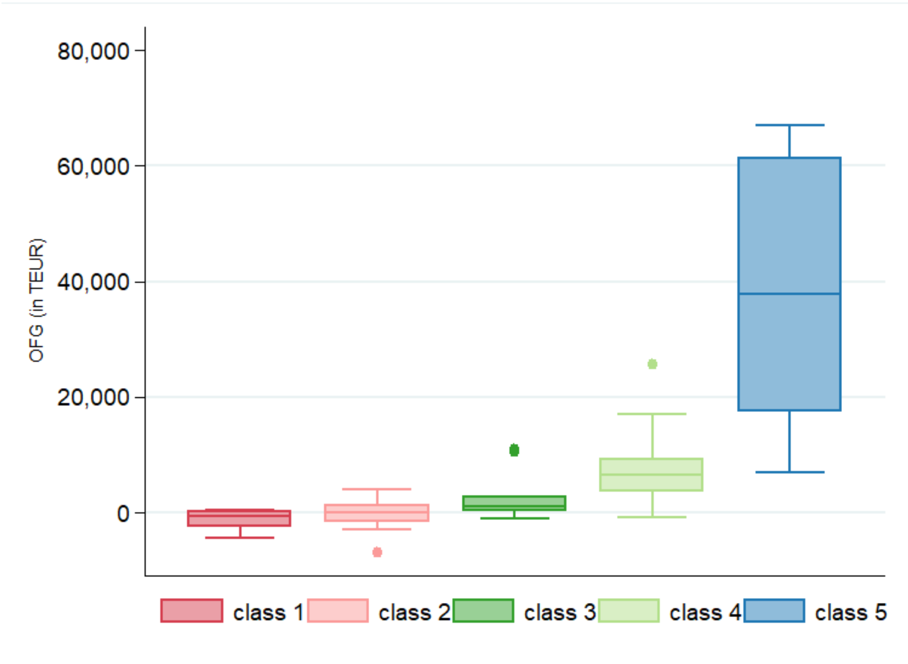
Source: Team based on sample data. Note: OFG is the Operating Funding Gap at the airport level. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "lfit" is a shortcut for "linear fit", a straight line representing the best linear prediction of the variable reported on the vertical axis (OFG) by the variable reported on the horizontal axis (passengers). "TEUR" is a shortcut for thousands of Euros.

Figure 7.1 clearly shows that the number of passengers positively correlates with the average OFG over the sample period: more passengers are related to higher profitability. However, there seems to be quite some heterogeneity within and across classes. The following graphs as well as the cluster and econometrics analysis presented in the next sections explores this heterogeneity to better assess the definition of the thresholds used in the Aviation Guidelines.

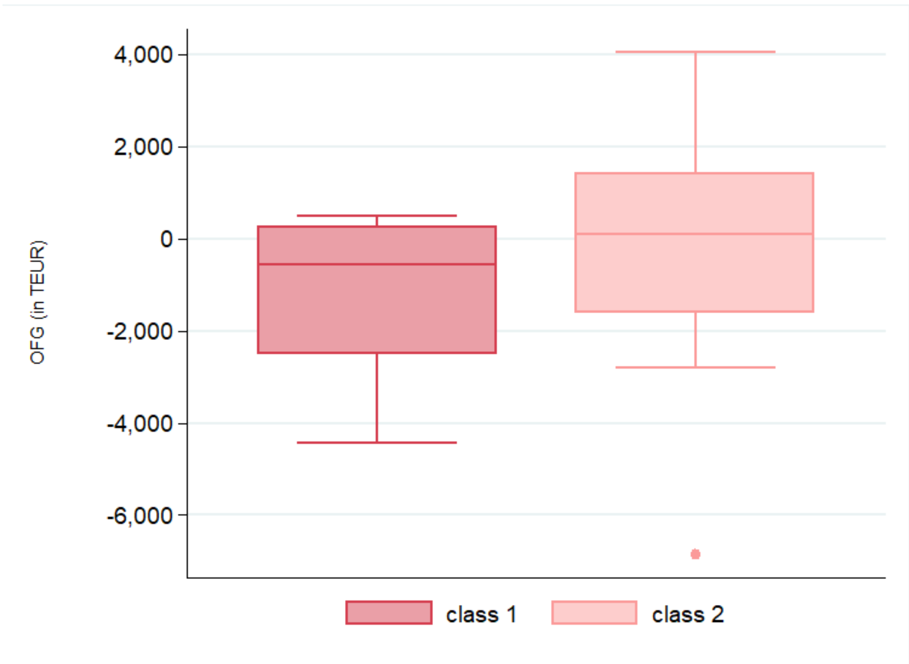
Figure 7.2 shows the distribution of OFG within classes. There is quite some heterogeneity between and within classes. In class 1, most of the distribution of the average OFG over the years 2015-2018 lies below zero. This is not true for the other classes, although some airports in classes 2, 3 and even 4 seem to have a negative average OFG over the years 2015-2018.

Figure 7.2. Boxplot of OFG (in TEUR based on average values over the years 2015-2018), by classes

Panel (a): all classes



Panel (b): focus on the first two classes



Source: Team based on sample data. The boxplot presents the distribution of OFG (Operating Funding Gap at the airport level), based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each class of airports. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "TEUR" is a shortcut for thousands of Euros.

To better assess how many airports do not appear to be profitable, Table 7.1 reports the number and percentage of airports with negative OFG over the period 2015-2018. The percentage of unprofitable airports significantly decreases between the higher the classes and is above 50% only for class 1.

Table 7.1. Fraction of airports with positive OFG (based on average values over the years 2015-2018), by class

Class	OFG Positive N airports	OFG Positive %	OFG Negative N airports	OFG Negative %
Class 1 (<200k)	3	38%	5	63%
Class 2 (200-700k)	15	58%	11	42%
Class 3 (700k-1M)	7	78%	2	22%
Class 4 (1-3M)	16	94%	1	6%
Class 5 (>3M)	7	100%	0	0%

Source: Team based on sample data. Based on 2015 to 2018 average OFG.

This preliminary analysis shows that, when airports are grouped based on their size in classes, there appears to be a positive relationship between the number of passengers and profitability. However, there still seems to be large heterogeneity within classes.[102] Some airports in the lower classes seem to be profitable, whereas some airports in the upper classes appear to be unprofitable. This suggests that, while the thresholds set up in the Aviation Guidelines to define the classes seem to be relevant, they might be potentially improved.

To assess whether this is the case, Figure 7.3 reports the distribution of the average OFG over the period 2015-2018 by groups ("bins") of 100,000 passengers. We report only the results up to 1 million passengers since, above that level, the distribution of average OFG lies almost completely above zero. The figure shows quite clearly that only airports in the first class (up to 200,000 passengers) have consistently negative or, in the best case, very small average OFG over the years 2015-2018.

Similarly, Figure 7.4 reports the fraction of airports with positive average OFG over the period 2015-2018. Here one can even better appreciate that the threshold of 200,000 passengers seems to identify a significant different group, as only up to that traffic level more than 50% of the airports have negative OFG. Again, it appears that airports with a traffic between 200,001 and 500,000 passengers are quite similar in terms of fraction of breaking even airports. Yet they seem different from airports with a traffic between 500,001 and 700,000 although all these airports are grouped in one class.[103]

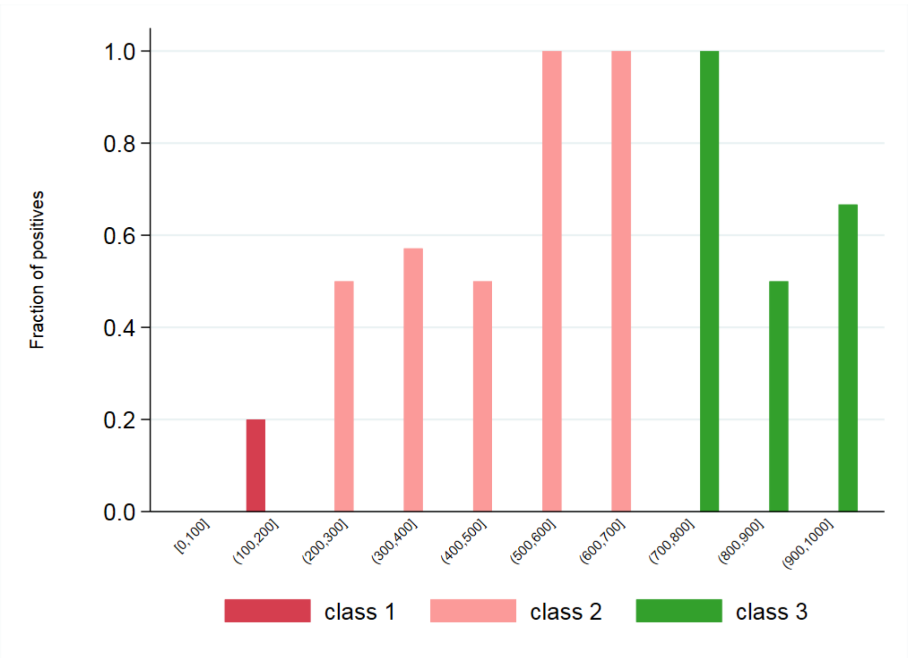
In Annex C, we report the same analysis but based on average predicted OFG values over the period 2019-2024. Results are even reinforced. This is reassuring, although one should bear in mind that the predicted measure is more speculative, as it is based on expectations.

[102] Please note that heterogeneity within classes of smaller sizes is to some extent visually artificially made smaller, because of the vertical scale adjusted to OFG of bigger airports.
[103] Given the small number of airports in each bin, these differences should be taken cautiously.

Figure 7.3. Boxplot of OFG (in TEUR based on average values over the years 2015-2018), by passenger levels

Source: Team based on sample data. Note: The figure is restricted to airports with an average number of passengers in the years 2015-2018 not exceeding 1 million passengers. The boxplot presents the distribution of the OFG (Operating Funding Gap at the airport level), based on respectively the minimum, the first quartile, the median, the third quartile, and the maximum values by airports' passenger levels. Airports are grouped into 5 classes based on the average number of passengers over the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "TEUR" is a shortcut for thousands of Euros.

Figure 7.4. Fraction of airports with positive OFG (based on average values over the years 2015-2018), by passenger levels



Source: Team based on sample data. Note: OFG is the Operating Funding Gap at the airport level. The figure is restricted to airports with an average number of passengers in the years 2015-2018 not exceeding 1 million passengers. Airports are grouped into 5 classes based on the average number of passengers over the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000).

7.2.2 Cluster analysis

As discussed in section 7.1.1, as a next step, we perform a cluster analysis to better understand what factors drives airports' profitability and how these interact with the number of passengers. This should help verify whether the classification based on passengers, *i.e.* the classes defended in the Aviation Guidelines, is correctly matching airports financial viability.

The aim of the cluster analysis is to classify airports into homogenous groups in terms of their level of OFG by means of statistical tools rather than by making subjective choices. Once these statistically homogenous clusters are constructed, we contrast them with the pre-defined classes set up by the Aviation Guidelines. By investigating the characteristics of airports within the different groups and classes, we aim to identify what factors influence profitability under which circumstances.

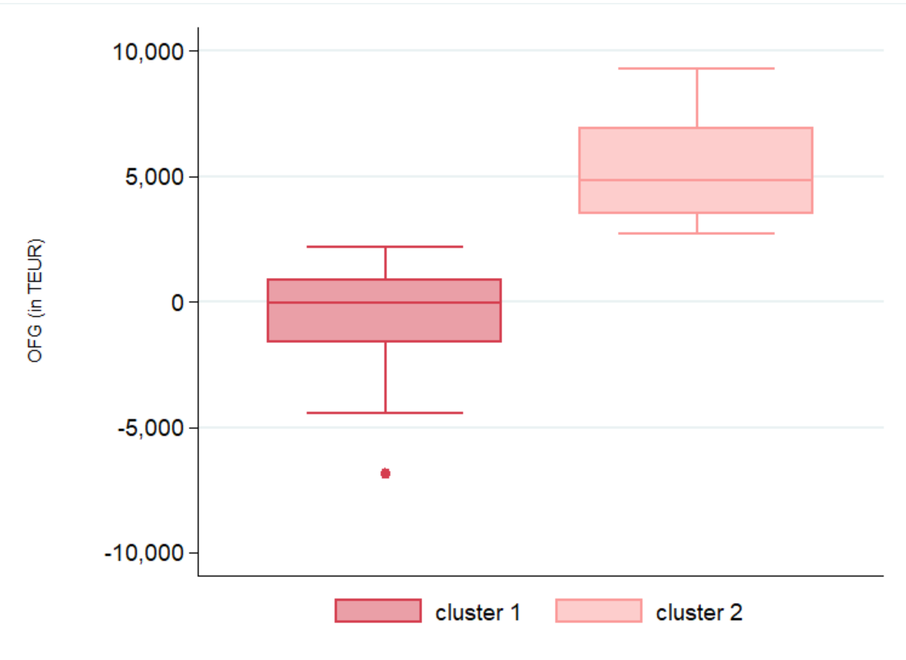
Again, the definition of the clusters is based on the average OFG of airports over the years 2015-2018, as data for these years were provided for most airports in our sample (see section 4.1.1). However, the statistical analysis carried out afterwards, is performed not by comparing the averages but by using the yearly data for each airport (again over the period 2015-2018).

The cluster analysis produces four main clusters: Figure 7.5 presents the four clusters (panel a), by focusing on the distributions of OFG. In Panel b, we zoom in in the first two clusters to have a cleaner picture of the distribution.

Figure 7.5. Boxplot of OFG (in TEUR based on average values over the years 2015-2018), by clusters

Panel (a): all clusters

Panel (b): focus on the first two clusters



Source: Team based on sample data. The boxplot presents the distribution of OFG (Operating Funding Gap at the airport level), based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each cluster of airports. Airports are grouped into clusters based on 2015 to 2018 OFG. Clusters' IDs are increasing in average OFG. "TEUR" is a shortcut for thousands of Euros.

Table 7.2 reports the summary statistics for the clusters.

Table 7.2. Summary statistics: OFG (in TEUR based on average values over the years 2015-2018), by clusters

Clusters	Mean TEUR	SD TEUR	Min TEUR	Max TEUR	N airports
Cluster 1	-458	1,881	-6,859	2,198	38
Cluster 2	5,236	2,086	2,700	9,284	16
Cluster 3	15,844	5,007	10,591	25,759	8
Cluster 4	52,425	13,956	37,734	66,921	4

Source: Team based on sample data. Clustering based on 2015 to 2018 OFG. Clusters' IDs are increasing in average OFG.

Cluster 1 entails 38 airports, which are more likely to be unprofitable. Their average OFG over the year 2015-2018 is €-458,000. Some airports within this group have, however, a positive OFG with a maximum value of € 2.2 million. The next cluster is composed by 16 airports, which are all profitable over the years 2015-2018. The average OFG is € 5.2 million and the least profitable airport in the cluster has OFG of € 2.7 million (which is above the maximum value from cluster 1). The next cluster entails 8 airports, which are even more profitable, with an average OFG over the years 2015-2018 of € 25 million. Finally, the last four airports are the most profitable ones with an average OFG of over € 52 million. Notice that the groups are well-defined as there is no overlap: the most profitable airport in each cluster is less profitable than the least profitable airports in the next cluster.

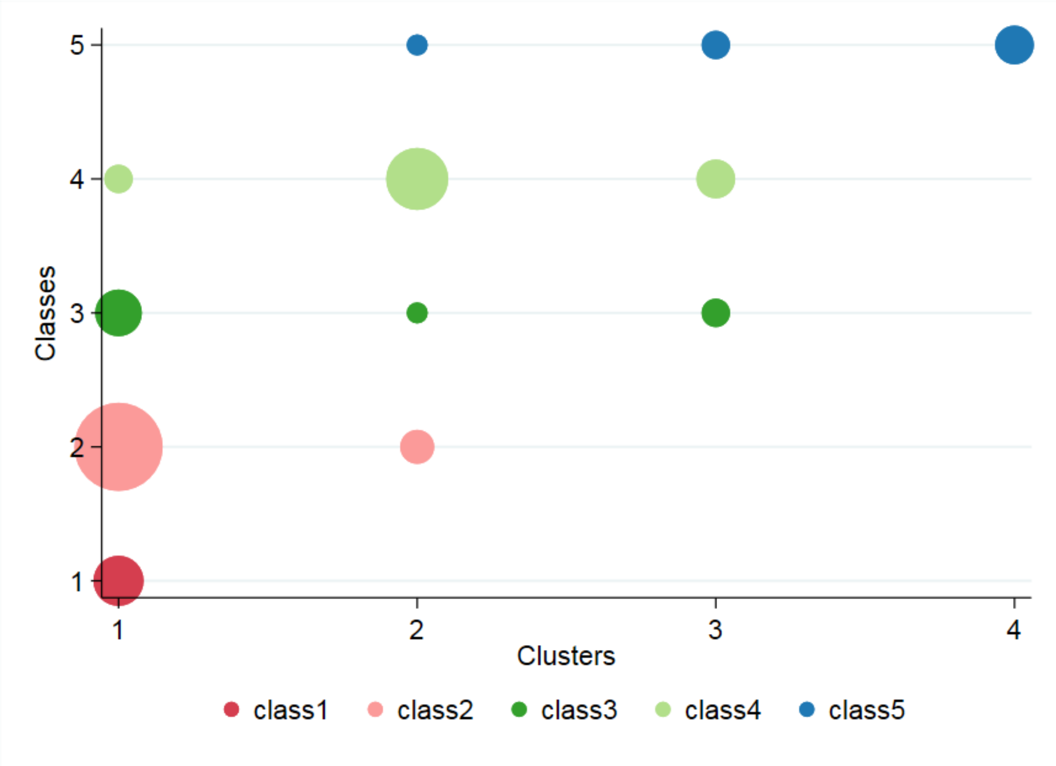
Table 7.3 and Figure 7.6 then shows how airports of different size classes were attributed to the respective profitability clusters.

Table 7.3. Number and percentage of airports (2015-2018), by cluster and class

Class	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total, by class
Class 1 (<200k)	7	0	0	0	7
	100%	0%	0%	0%	100%
Class 2 (200-700k)	23	3	0	0	26
	88%	12%	0%	0%	100%
Class 3 (700k-1M)	6	1	2	0	9
	67%	11%	22%	0%	100%
Class 4 (1-3M)	2	11	4	0	17
	12%	65%	24%	0%	100%
Class 5 (>3M)	0	1	2	4	7
	0%	14%	29%	57%	100%
Total, by cluster	38	16	8	4	66
	58%	24%	12%	6%	100%

Source: Team based on sample data. Clustering based on 2015 to 2018 OFG. Clusters' IDs are increasing in average OFG.

Figure 7.6. Number of airports (2015-2018), by cluster and class



Source: Team based on sample data. Note: On the one side (vertical axis), airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). On the other side (horizontal axis), airports are grouped into clusters based on 2015 to 2018 OFG, where OFG is an airport's Operating Funding Gap. Clusters' IDs are increasing in average OFG.

Our results show that all of the smallest airports in our sample (class 1) were classified within the first cluster. While for the remaining classes this is not as clear-cut. Some patterns emerge. The majority of class 2 airports (88%) and class 3 airports (67%) belong to cluster 1. Most class 4 airports (65%) belong to cluster two, while most of class 5 airports belong to cluster 4. Cluster 3 is formed by a mix of airports from classes 3, 4, and 5 which appear to be particularly well performing.

These findings reflect again the notion that passengers may indeed be a relevant – yet not the only – driver of airports' profitability.

As a next step, we investigate the characteristics of airports within a class and across different clusters to assess whether other factors discussed in the literature may play a role in determining airport profitability. For instance, which observable characteristics are correlated with the fact that some airports in class 2 are more profitable (belong to cluster 2) while others are less so (belong to cluster 1). These include airport characteristics (number of passengers, fraction of LCC passengers, top airlines' share in revenues, ownership), subsidies paid to the airport (operating aid per passenger, investment aid per passenger), incentives granted to airlines, competition variables (number of competitors, number of airports in catchment area), as well as regional characteristics (GDP per capita, employment, total transported goods).

Table 7.4 reports the comparison of the means for the different profitability measures and potential drivers of profitability for class 2 airports, distinguishing between those belonging to cluster 1 and those belonging to cluster 2.

Table 7.4. Comparison of means of variables (2015-2018) in clusters: class 2

Variables	Means		Difference in means (Mean comparison t-tests)	
	Cluster 1	Cluster 2	Cluster 1 vs. Cluster 2	
Profitability/efficiency measures				
OFG [TEUR]	-526.7	3,620.7	-4,147.5	***
OFG per pax [EUR]	-2.2	7.4	-9.6	***
OPEX per pax [EUR]	24.1	19.8	4.3	
Passengers/passenger characteristics				
Passengers ['000]	368.0	522.0	-154.0	***
Fraction of LCC pax	0.4	0.1	0.3	***
Aid				
Operating aid per pax [EUR]	1.1	0.0	1.1	*
Operating aid granted in 2010-18 [0/1]	0.3	0.0	0.3	**
Investment aid per pax [EUR]	1.0	0.6	0.5	
Investment aid granted in 2010-18 [0/1]	0.4	0.7	-0.3	*
Business/ownership situation				
Private airport [0/1]	0.3	0.7	-0.4	***
Incentives to airlines [TEUR]	774.4	719.8	54.6	
Incentives to airlines per pax [EUR]	2.1	1.3	0.9	
Fraction of non-aviation revenues	0.2	0.3	0.0	
Improving measures in 2014-18 [0/1]	0.2	0.7	-0.4	***
Congestion in 2014-20 [0/1]	0.2	0.1	0.1	
Shock suffered in 2014-20 [0/1]	0.3	0.4	-0.1	
Top1 airline's revenue share in 2018	0.5	0.6	-0.1	
Competitive environment				
# of airports in catchment area in 2018	0.7	0.3	0.4	
# of competing airports in 2018	2.7	2.0	0.7	
Local economic conditions				
GDP in PPS per inhabitant	28,204.0	27,572.2	631.8	
Population ['000]	731.4	1,496.6	-765.2	***
Employment rate	0.4	0.3	0.1	

Table 7.4. Comparison of means of variables (2015-2018) in clusters: class 2

Variables	Means		Difference in means (Mean comparison t-tests)	
	Cluster 1	Cluster 2	Cluster 1 vs. Cluster 2	
Total transported goods by region of unloading ['000 t]	13,866.1	37,857.5	-23,991.4	***
N of airports	**23**	**3**		

*Source: Team based on sample data. Please note that for time invariant variables (Top1 airline's share of pax revenues in 2018, # of airports in catchment area in 2018, # of competing airports in 2018), only values in 2018 were used to perform mean-comparison tests. Units of measure in square brackets: TEUR stands for thousand Euros; ['000 t] stands for thousand tons, [0/1] indicates a dummy variable. The number of stars in the last column indicates the level of statistical significance resulting from the t-tests: * (p<0.10), ** (p<0.05), *** (p<0.01).*

Clearly, since the cluster analysis is based on profitability, class 2 airports belonging to cluster 1 have significantly lower profitability than those belonging to cluster 2. The results suggest that they have, on average, a smaller number of passengers (154,000 less), but a greater fraction of LCC passengers (30 p.p. more) as compared to class 2 airports belonging to cluster 2. They also receive, on average, significantly more operating aid per passenger (€ 1.1) and also more investment aid (€ 0.5) although the latter difference is not significant. The less profitable class 2 airports tend to be less often privately owned (40 p.p. less). Moreover, class 2 airports that are more profitable (cluster 2), are those that introduced more frequently improving measures in the period 2014-2018. Finally, the less profitable are airports located in less attractive areas with lower population (765,200 people less) and lower transportation infrastructure (almost 24 million tons less transported goods), which may help explain why they provide, on average, more incentives to airlines per passenger (€ 0.9) – though this difference is not statistically significant.

Table 7.5, Table 7.6 and Table 7.7 do the same exercise, but for airports in classes 3, 4 and 5 respectively, by focusing on the differences between airports from the same class but belonging to different clusters (clusters 1 to 3 in the case of classes 3 and 4; clusters 2 to 4 in the case of class 5).

Table 7.5. Comparison of means of variables (2015-2018) in clusters: class 3

Variables	Means			Difference in means (Mean comparison t-tests)			
	Cluster 1	Cluster 2	Cluster 3	Cluster 1 vs. Cluster 2		Cluster 2 vs. Cluster 3	
Profitability/efficiency measures							
OFG [TEUR]	559.4	2,764.9	10,784.9	-2,205.5	***	-8,020.0	***
OFG per pax [EUR]	0.4	3.2	10.7	-2.8	***	-7.5	***
OPEX per pax [EUR]	10.8	16.1	14.5	-5.3	***	1.5	
Passengers/passenger characteristics							
Passengers ['000]	992.3	872.1	1,012.3	120.2		-140.2	***
Fraction of LCC pax	0.6	0.0	0.2	0.6	***	-0.2	*
Aid							
Operating aid per pax [EUR]	0.9	0.0	0.0	0.9		0.0	
Operating aid granted [0/1]	0.7	0.0	0.0	0.7	**	0.0	
Investment aid per pax [EUR]	0.9	0.0	0.0	0.9		0.0	
Investment aid granted [0/1]	0.4	0.0	0.0	0.4		0.0	
Business/ownership situation							
Private airport [0/1]	0.2	1.0	0.0	-0.8	***	1.0	
Incentives to airlines [TEUR]	1,400.6	2,236.5	2,710.0	-835.9		-473.5	
Incentives to airlines per pax [EUR]	1.4	2.5	2.7	-1.1		-0.2	
Fraction of non-aviation revenues	0.3	0.4	0.4	-0.1		-0.1	
Improving measures 2014-18 [0/1]	0.1	0.0	0.6	0.1		-0.6	**
Congestion in 2014-18 [0/1]	0.2	0.0	0.0	0.2		0.0	
Shock suffered in 2014-18 [0/1]	0.7	0.0	0.1	0.7	**	-0.1	
Top1 airline's revenue share in 2018	0.4	0.6	0.5	-0.2		0.1	
Competitive environment							
# of competing airports in 2018	4.0	1.0	2.5	3.0		-1.5	
# of airports in catchment area in 2018	0.5	0.0	1.5	0.5		-1.5	
Local economic conditions							
GDP in PPS per inhabitant	24,113.4	24,466.7	34,800.0	-353.3		-10,333.3	*
Population ['000]	639.9	775.7	1,122.6	-135.8		-346.9	
Employment rate	0.4	0.5	0.4	-0.1	**	0.1	

Table 7.5. Comparison of means of variables (2015-2018) in clusters: class 3

Variables	Means			Difference in means (Mean comparison t-tests)			
	Cluster 1	Cluster 2	Cluster 3	Cluster 1 vs. Cluster 2		Cluster 2 vs. Cluster 3	
Total transported goods by region of unloading ['000 t]	13,386.4	15,504.7	22,354.3	-2,118.3		-6,849.7	
N	**6**	**1**	**2**				

*Source: Team based on sample data. Please note that for time invariant variables (Top1 airline's share of pax revenues in 2018, # of airports in catchment area in 2018, # of competing airports in 2018), only values in 2018 were used to perform mean-comparison tests. Units of measure in square brackets: TEUR stands for thousand Euros; ['000 t] stands for thousand tons, [0/1] indicates a dummy variable. The number of stars in the last column indicates the level of statistical significance resulting from the t-tests: * (p<0.10), ** (p<0.05), *** (p<0.01).*

For class 3 as well, the results suggest that less profitable airports are characterised by a significantly higher average fraction of LCC passengers. While class 3 airports belonging to cluster 2 (the mid-profitable) are all private, none of the very profitable class 2 airport is. Finally, our results suggest that the most profitable airports in class 3 are also those which introduced more frequently improving measures in the years 2014-2018.

Table 7.6. Comparison of means of variables (2015-2018) in clusters: class 4

Variables	Means			Difference in means (Mean comparison t-tests)			
	Cluster 1	Cluster 2	Cluster 3	Cluster 1 vs. Cluster 2		Cluster 2 vs. Cluster 3	
Profitability/efficiency measures							
OFG [TEUR]	617.6	5,746.1	17,317.7	-5,128.5	***	-11,571.6	***
OFG per pax [EUR]	0.6	3.3	6.3	-2.7	***	-3.0	***
OPEX per pax [EUR]	10.2	13.0	14.1	-2.8		-1.0	
Passengers/passenger characteristics							
Passengers ['000]	1,270.9	1,940.6	2,914.9	-669.7	***	-974.2	***
Fraction of LCC pax	0.5	0.5	0.2	0.0		0.3	***
Aid							
Operating aid per pax [EUR]	0.9	0.0	0.0	0.9	***	0.0	
Operating aid granted [0/1]	1.0	0.1	0.3	0.9	***	-0.2	
Investment aid per pax [EUR]	0.4	0.2	0.6	0.3		-0.4	
Investment aid granted [0/1]	0.5	0.3	0.3	0.2		0.1	
Business/ownership situation							

Table 7.6. Comparison of means of variables (2015-2018) in clusters: class 4

Variables	Means			Difference in means (Mean comparison t-tests)			
	Cluster 1	Cluster 2	Cluster 3	Cluster 1 vs. Cluster 2		Cluster 2 vs. Cluster 3	
Private airport [0/1]	0.4	0.2	0.0	0.2		0.2	*
Incentives to airlines [TEUR]	269.2	1,809.1	3,074.9	-1,539.9	*	-1,265.8	
Incentives to airlines per pax [EUR]	0.2	0.8	1.0	-0.6	*	-0.2	
Fraction of non-aviation revenues	0.3	0.3	0.4	-0.1		-0.1	*
Improving measures 2014-18 [0/1]	0.0	0.3	0.3	-0.3		0.0	
Congestion in 2014-18 [0/1]	0.0	0.2	0.5	-0.2		-0.3	***
Shock suffered in 2014-18 [0/1]	NA	0.1	0.3	NA	NA	-0.2	*
Top1 airline's revenue share in 2018	NA	0.6	0.3	NA	NA	0.3	**
Competitive environment							
# of competing airports in 2018	NA	3.9	3.3	NA	NA	0.6	
# of airports in catchment area in 2018	NA	1.1	2.0	NA	NA	-0.9	
Local economic conditions							
GDP in PPS per inhabitant	22,028.8	32,166.7	30,899.8	-10,137.9	**	1,266.8	
Population ['000]	729.4	802.4	578.7	-73.0		223.7	
Employment rate	0.4	0.5	0.4	-0.1	*	0.0	
Total transported goods by region of unloading ['000 t]	22,082.7	20,200.0	21,811.6	1,882.7		-1,611.6	
N	**2**	**11**	**4**				

*Source: Team based on sample data. Please note that for time invariant variables (Top1 airline's share of pax revenues in 2018, # of airports in catchment area in 2018, # of competing airports in 2018), only values in 2018 were used to perform mean-comparison tests. Units of measure in square brackets: TEUR stands for thousand Euros; ['000 t] stands for thousand tons, [0/1] indicates a dummy variable. The number of stars in the last column indicates the level of statistical significance resulting from the t-tests: * (p<0.10), ** (p<0.05), *** (p<0.01).*

When comparing differences in means, class 4 airports classified as less profitable (cluster 1) are characterized by a significantly lower number of passengers. In addition, as compared to the remaining two profitability clusters in class 4, the less profitable airports in class 4 receive significantly more operating aid. Notice that this correlation is most likely to have the reverse causality interpretation: these airports receive more aid *because* they are less profitable and not the other way around. As before, the table also provides some suggestions that less profitable airports are located in less advantageous areas, as measured by GDP per capita or employment rate. We also find that the most profitable airports (cluster 3) are those which have a higher fraction of non-aviation revenues. A more puzzling result is that the most profitable airports in class 4 (cluster 3) suffered more frequently periods of congestion and shocks over the years 2014-2018.

Table 7.7. Comparison of means of variables (2015-2018) in clusters: class 5

Variables	Means			Difference in means (Mean comparison t-tests)			
	Cluster 2	Cluster 3	Cluster 4	Cluster 2 vs. Cluster 3		Cluster 3 vs. Cluster 4	
Profitability/efficiency measures							
OFG [TEUR]	6,949.5	17,957.0	52,425.4	-11,007.5	***	-34,468.4	***
OFG per pax [EUR]	1.7	4.3	10.3	-2.5	***	-6.0	***
OPEX per pax [EUR]	7.9	10.2	6.3	-2.3	***	3.9	***
Passengers/passenger characteristics							
Passengers ['000]	3,976.1	4,236.3	5,276.5	-260.3		-1,040.2	***
Fraction of LCC pax	0.5	0.6	0.3	-0.1		0.3	***
Aid							
Operating aid per pax [EUR]	0.0	0.0	0.0	0.0		0.0	
Operating aid granted [0/1]	0.0	0.0	0.0	0.0		0.0	
Investment aid per pax [EUR]	1.0	0.1	0.0	0.9	***	0.1	**
Investment aid granted [0/1]	1.0	0.5	0.3	0.5	*	0.2	
Business/ownership situation							
Private airport [0/1]	0.0	0.5	0.5	-0.5	*	0.0	
Incentives to airlines [TEUR]	3,047.6	8,497.4	1,662.5	-5,449.8	**	6,834.9	***
Incentives to airlines per pax [EUR]	0.7	2.0	0.3	-1.3	***	1.7	***
Fraction of non-aviation revenues	0.3	0.3	0.4	0.0		-0.1	
Improving measures 2014-18 [0/1]	1.0	0.4	0.3	0.6	**	0.1	
Congestion in 2014-2018 [0/1]	1.0	0.0	0.6	1.0		-0.6	***

Table 7.7. Comparison of means of variables (2015-2018) in clusters: class 5

Variables	Means			Difference in means (Mean comparison t-tests)			
	Cluster 2	Cluster 3	Cluster 4	Cluster 2 vs. Cluster 3		Cluster 3 vs. Cluster 4	
Shock suffered in 2014-2018 [0/1]	0.0	0.5	0.3	-0.5	*	0.3	
Top1 airline's share of pax revenues in 2018	0.4	0.3	0.3	0.1		0.0	
Competitive environment							
# of competing airports in 2018	2.0	3.5	3.7	-1.5		-0.2	
# of airports in catchment area in 2018	0.0	1.0	1.8	-1.0		-0.8	
Local economic conditions							
GDP in PPS per inhabitant	24,902.9	26,567.8	39,552.1	-1,664.8		-12,984.3	***
Population ['000]	561.2	1,773.7	1,970.4	-1,212.5	***	-196.7	
Employment rate	0.4	0.4	0.4	0.0		0.0	
Total transported goods by region of unloading ['000 t]	5,571.3	16,506.7	40,483.8	-10,935.3	**	-23,977.1	**
N of airports	**1**	**2**	**4**				

*Source: Team based on sample data. Please note that for time invariant variables (Top1 airline's share of pax revenues in 2018, # of airports in catchment area in 2018, # of competing airports in 2018), only values in 2018 were used to perform mean-comparison tests. Units of measure in square brackets: TEUR stands for thousand Euros; ['000 t] stands for thousand tons, [0/1] indicates a dummy variable. The number of stars in the last column indicates the level of statistical significance resulting from the t-tests: * (p<0.10), ** (p<0.05), *** (p<0.01).*

When looking at airports in class 5, airports belonging to cluster 2 (the less profitable in the class) have, on average, less passengers than airports belonging to the other two clusters. Moreover, they are characterised by a significantly lower fraction of private airports and receive, on average, significantly more investment aid per passenger. They are also paying higher incentives to airline per passenger than class 5 airports belonging to cluster 4 (but not cluster 3) and are located in poorer and less populated areas.

The cluster analysis and the additional comparison of the means provide some preliminary insights on airport characteristics, which may play a key role for profitability. Overall, we find that higher traffic levels are indeed related to higher profitability. An increase in the fraction of LCC passengers, on the other hand, seems to be associated with lower profitability. This is particularly true for smaller airports. Our results also suggest that, when considering regional characteristics, airports in less attractive regions appear to be less profitable.

In Annex C, we perform the cluster analysis on an alternative measure of profitability: (1) the alternative airports' funding gap (already introduced in section 6.1.1 with the acronym AFG), inclusive of capital costs non-eligible for investment aid and (2) EBIT adjusted, that is Earnings before interests and taxes minus operating aid. Our results are quantitatively similar, with the difference that the entire distribution is shifted downwards. Yet, this definition of profitability is not the right one to look at when considering the adequacy of airports' categorisation for operating aid rules. EBIT adjusted equals EBITDA minus public operating aid minus all capital costs accrued in a given year (i.e. total depreciations and amortization), including the ones that are already eligible for investment aid. Thus, EBIT adjusted does not allow to control for capital costs for which an airport may be entitled to receive (or may indeed have received) a different type of public support. In this sense, AFG appears to be a better measure because, as explained in detail in Annex B, it aims at including among funding needs only capital costs that are not eligible for investment aid. However, due to lack of data about capital costs, the practical implementation of the measure in this Study is imperfect and captures only a very rough estimate of capital costs non-eligible for investment aid. In any circumstance, any consideration regarding public support of capital costs within the scope of operating aid may be better assessed looking jointly at both operating aid and investment aid.

7.2.3 Econometrics analysis

Main results

In the cluster analysis (section 7.2.2), as well as in the literature review (see section 3), we observe that several characteristics (other than the number of passengers alone) play also an important role for profitability. However, it is not clear whether these factors are correlated among each other and which of them is more important once we control for the others.

Thus, building on the results obtained from the cluster analysis and to better capture the relationship between passengers and profitability, we introduce a multivariate regression framework. Putting all time-variant drivers of profitability into a multivariate regression model allows us to account for the correlation across these observables. We also introduce airport fixed-effects to account for unobserved time-invariant heterogeneity across airports, as well as time trends to account for aggregate uncertainty affecting all airports over time. In this way, the measured correlation between traffic and profitability should be less spurious.

Table 7.8 presents the first set of results. As in the previous sections, we solely focus on OFG, although similar results can be obtained also for other profitability measures. First, we consider a simple fixed-effects regression by focusing on the level of total passengers on profitability. Second, we distinguish between the two main types of passengers: LCC and HC versus FNC, which are observed to be highly correlated with the profitability level. Finally, we consider other possible time-varying determinants of profitability: incentives to airlines per passenger, operating aid per passenger, and investment aid per passenger.[104]

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[104] In our estimations, we have also considered regional characteristics provided by Eurostat, including gross domestic product (GDP) per capita, employment, and total transported goods. Our results remain

Table 7.8. Regressions on OFG (2010-2018)

Variables	OFG (1)	OFG (2)	OFG (3)
Pax: total ['000]	6.89***		
	[1.45]		
LCC and HC pax ['000]		5.84***	6.32***
		[1.61]	[1.63]
Full network carriers ['000]		9.69***	10.4***
		[1.56]	[0.98]
Incentives to airlines per pax [EUR]			-321.7***
			[106.2]
Operating aid per pax [EUR]			-240.7
			[191.0]
Investment aid per pax [EUR]			23.4
			[26.9]
Constant	-309,000.6*	-285,420.7	-167,358.3
	[183,966.3]	[184,634.9]	[125,639.4]
Fixed effects	yes	yes	yes
Clustered SE	yes	yes	yes
Year trends	yes	yes	yes
Observations	511	475	396
F	17	15	26

*Source: Team based on sample data. * (p<0.10), ** (p<0.05), *** (p<0.01). Standard errors in parentheses.*

Three main observations can be drawn from these results. First, for all specifications considered, we find a positive and strongly significant effect of passengers on profitability. Specifically, we find that an increase in passengers by 1,000, is correlated with an increase in profitability by approximately 6,000-7,000 EUR. Second, when considering our aggregate sample (without distinguishing between the respective classes), the different types of passengers (LCC and HC[105] *versus* FNC) do not have fundamentally different effect on profitability: although the effect is much smaller for LCCs and HC passengers than for FNC passengers, both coefficients are positive and statistically significant. Third, incentives to airlines have a significant negative impact on airport profitability, which we did not observe so strongly in the cluster analysis: additional € 1

qualitatively the same, when including them. However, as these are not provided for 2018, including them in our model comes at a cost of losing a substantial number of observations. This is critical for our remaining analyses, given our small sample size. We therefore present the results where we do not control for these additional variables.

[105] Holiday carrier passengers do not seem to have a specific pattern and, if at all, to be more similar to LCC than to FN, so we put them together (we need to use as few variables as possible.

incentives per passenger paid to the airlines is correlated to a decrease by over € 320,000 OFG. This latter result stresses the importance of controlling for other important drivers of profitability in order to correctly assess the correlation between each of them and the profitability measure.

This aggregate picture ignores possible heterogeneity between classes, which was one of the main findings derived from our descriptive and cluster analyses. Therefore, regressions by class are useful to provide further evidence of heterogeneity for airports of a similar size. Table 7.9 presents the results of our chosen model by class.

Table 7.9. Regressions on OFG (2010-2018), by class

Variables	OFG Total	OFG Class 1	OFG Class 2	OFG Class 3	OFG Class 4	OFG Class 5
LCC and HC pax ['000]	6.32***	-5.56***	1.46	4.46***	1.64**	9.87***
	[1.63]	[1.09]	[1.20]	[0.35]	[0.68]	[1.76]
FNC pax ['000]	10.4***	4.27	5.35*	10.3***	3.80*	11.9***
	[0.98]	[8.29]	[2.61]	[0.39]	[1.83]	[0.67]
Incentives to airlines per pax [EUR]	-321.7***	-114.6***	-255.7***	-290.1	-799.4	-1,960.2
	[106.2]	[30.4]	[19.2]	[283.3]	[500.3]	[1,207.6]
Operating aid per pax [EUR]	-240.7	-41.1**	-36.0	-495.7*	-402.3	0
	[191.0]	[16.7]	[63.6]	[221.8]	[346.1]	[.]
Investment aid per pax [EUR]	23.4	17.9	1.03	465.6***	33.4	0
	[26.9]	[31.0]	[6.64]	[117.3]	[47.9]	[.]
Constant	-167,358.3	14,576.0	-186,460.2**	31,919.6	-763,077.9	290,981.1
	[125,639.4]	[33,289.2]	[79,881.6]	[130,535.3]	[534,063.6]	[588,779.2]
Fixed effects	yes	yes	yes	yes	yes	yes
Clustered SE	yes	yes	yes	yes	yes	yes
Year trends	yes	yes	yes	yes	yes	yes
Observations	396	54	140	57	93	52
F	26	160	235	24,363	220	381

*Source: Team based on sample data. * (p<0.10), ** (p<0.05), *** (p<0.01). Standard errors in parentheses.*

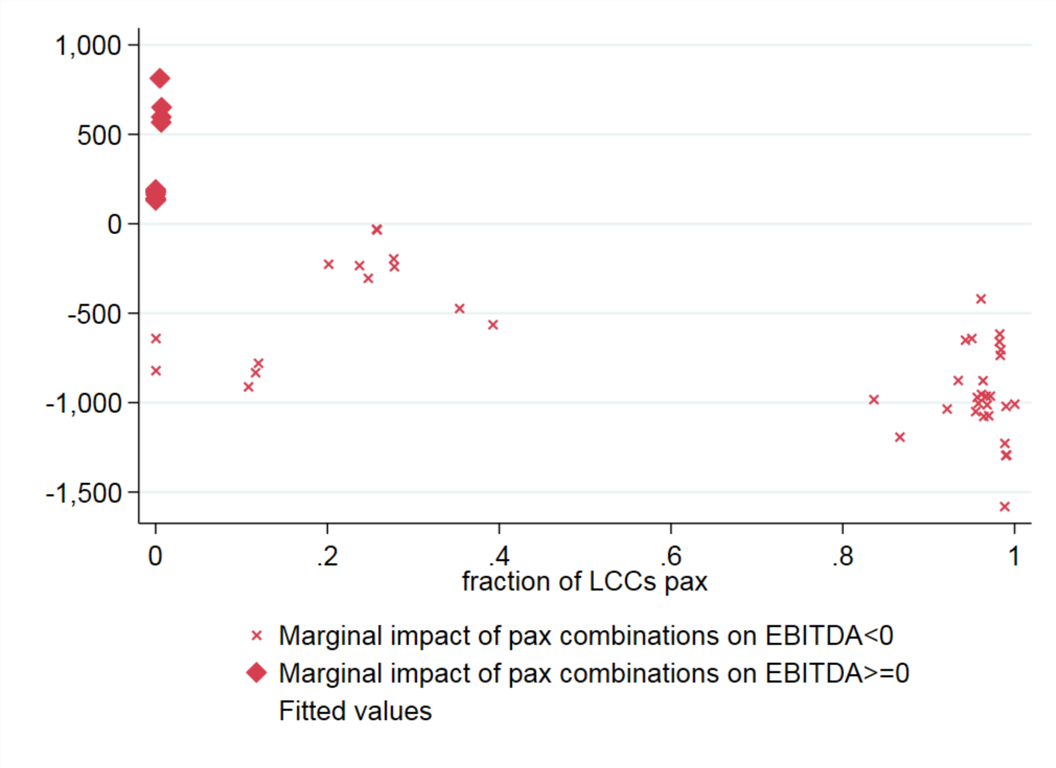
As already suggested by Figure 7.1, the level of passengers has a different impact on profitability, depending on the class of airports considered. Two additional findings also appear from our class-by-class model. First, for the smallest airports (class 1), the effect of passengers on profitability strongly depends on the type of passengers considered. Small airports' profitability may actually deteriorate when LCC and HC traffic increases. Second, the remaining drivers of profitability considered in our model have a heterogeneous effect across classes. For instance, our results suggest that incentives paid to airlines have a negative impact on are negatively correlated with the airports' profitability, but this effect is statistically significant only for the smaller ones (classes 1 and 2). Controlling for other factors, the relationship between operating aid and OFG is always negative and statistically significant for class 1 and 3, while is not significant for the other classes. As discussed above, this result is most likely to uncover the reverse correlation: operating aid is the higher, the lower the profitability. Finally, investment aid is positively and significantly correlated with profitability in class 3.

In the next sub-sections, we focus and explore in more detail these first two key findings discussed above.

Deteriorating impact of LCC and HC passengers for the smallest airports

The first key finding of our econometric analysis presented in Table 7.9 is that the presence of LCC and HC passengers may have a deteriorating impact on smallest airports' (class 1) profitability. This may lead a different overall effect of passengers on OFG for airports in this class. We identify two groups of class 1 airports: (1) those with an overall negative marginal impact of total passengers on OFG, and (2) those with a positive impact of total passengers on OFG. To explore this point further, Figure 7.7 shows the net predicted impact of passengers on OFG, by fraction of LCC passengers.

Figure 7.7. Net predicted impact of passengers on OFG in class 1, by total number of passengers



Source: Team based on sample data.

Figure 7.7 suggests that these two groups of airports are characterised by different patterns. Only for airports with a small (almost zero) fraction of LCC passengers, the marginal effect of passengers on OFG is positive. This raises the question of whether other observable characteristics can also help explain these differences. Yet, we do not have enough observations to develop our regression framework in order to answer this question. In addition, some potentially relevant drivers (top airlines' share of passengers, number of competitors, number of airports in catchment area, ownership) are time invariant and cannot be used in a fixed-effects regression methodology.

These arguments motivate the introduction of a simpler tool to perform the comparison across these two different groups of class 1 airports. Specifically, as we have done in the previous section, we simply statistically compare the means of the observable characteristics between the two groups of airports.[106] The results of the analysis are presented in Table 7.10.

[106] Notice that this analysis complements the cluster analysis, where within class 1 differences were not explored, as all airports in this class were classified into one cluster. While there the focus was the profitability of airports, here we explore what can explain that for some small airports, passengers may have a negative impact on profitability.

Table 7.10. Comparison of means of variables between airports with (1) positive vs. (2) negative marginal effect of total passengers on OFG

Variables	Means		Difference in means (t-tests)	
	Negative impact	Positive impact	Negative vs. Positive	
Profitability/efficiency measures				
OFG [TEUR]	-1,267.5	-1,601.2	333.7	
OFG per pax [EUR]	-7.4	-14.7	7.4	**
OPEX per pax [EUR]	28.8	29.9	-1.0	
Passengers/passenger characteristics				
Passengers ['000]	179.7	77.7	102.0	***
Fraction of LCC pax	0.7	0.0	0.7	***
Aid				
Operating aid per pax [EUR]	3.5	8.1	-4.6	**
Operating aid granted in 2010-18 [0/1]	0.2	1.0	-0.8	***
Investment aid per pax [EUR]	0.3	3.1	-2.9	***
Investment aid granted in 2010-18 [0/1]	0.3	0.7	-0.4	**
Business/ownership situation				
Private airport [0/1]	0.5	0.0	0.5	***
Incentives to airlines [TEUR]	1,381.0	2.4	1,378.6	***
Incentives to airlines per pax [EUR]	7.6	0.0	7.6	***
Fraction of non-aviation revenues	0.2	0.2	0.1	
Improving measures in 2014-18 [0/1]	0.3	0.0	0.3	*
Congestion in 2014-2018 [0/1]	0.0	0.0	0.0	
Shock suffered in 2014-18 [0/1]	0.3	0.8	-0.5	**
Top1 airline's revenue share 2018	0.6	0.6	0.0	
Competitive environment				
# of competing airports in 2018	3.0	0.0	3.0	
# of airports in catchment area in 2018	1.0	1.5	-0.5	
Local economic conditions				
GDP in PPS per inhabitant	30,325.0	33,100.0	-2,775.0	
Population ['000]	690.6	638.1	52.5	
Employment rate	0.4	0.5	-0.1	

Table 7.10. Comparison of means of variables between airports with (1) positive vs. (2) negative marginal effect of total passengers on OFG

Variables	Means		Difference in means (t-tests)	
	Negative impact	Positive impact	Negative vs. Positive	
Total transported goods by region of unloading ['000 t]	18,039.4	31,096.3	-13,056.9	***
N of airports	**41**	**13**		

*Source: Team based on sample data. Please note that for time invariant variables (Top1 airline's share of pax revenues in 2018, # of airports in catchment area in 2018, # of competing airports in 2018), only values in 2018 were used to perform mean-comparison tests. Units of measure in square brackets: TEUR stands for thousand Euros; ['000 t] stands for thousand tons, [0/1] indicates a dummy variable. The number of stars in the last column indicates the level of statistical significance resulting from the t-tests: * (p<0.10), ** (p<0.05), *** (p<0.01).*

Our analysis suggests that there are important differences in the mean characteristics of the two groups of airports. Specifically, airports for which the marginal effect of larger traffic on profitability is positive are, on average, characterised by a significantly smaller number of passengers and, especially, a smaller fraction of LCC passengers. These are also airports, which, on average, pay fewer incentives to airlines and have higher operating as well as investment aid per passenger. Less intuitive is that these are airports were, on average, more exposed to shocks throughout the period 2014-2018. Finally, none of them is private and none of them has introduced improving measures over the years 2014-2018.

Even more heterogeneity: the mediated effect of passengers on profitability

The last step of the analysis is to add even more heterogeneity and see whether the effect of passengers on profitability is mediated by other variables. For this purpose, we introduce interactions of passengers with other drivers of profitability. We focus on the characteristics that have been identified to be important in the previous analyses: incentives to airlines per passenger, operating aid per passenger, investment aid per passenger.

Given the small sample size, we are not able to introduce these additional interactions when using our class-by-class regressions. Therefore, instead of sub-samples, we use interactions between classes, passengers and additional drivers/dimensions of profitability considered.[107]

Moreover, we cannot use all the interactions at once. Therefore, we introduce separate models, focusing each time on the interactions of passengers and classes with one potential drivers/dimension of profitability.

Table 7.11 reports the results of various specifications including interactions of passengers and classes respectively with each of our continuous potential drivers of profitability. Here, the

[107] Indeed, given the small class sub-sample sizes and the complexity of the models introduced in this section, for estimations based on sub-samples, the estimated coefficients are not identified.

underlying question is whether, in a given class, passengers may have a different impact on profitability, depending on respectively the level of incentives paid to airlines per passenger (column 1), as well as operating aid per passenger (column 2) and investment aid per passenger received by airports (column 3). If this is indeed the case, this may suggest that a categorization based solely on passengers does not capture sufficiently well the financial situation of airports.

Table 7.11. Regressions on OFG (2010-2018), including interactions of linear variables with passengers and class

Variables	OFG (1)	OFG (2)	OFG (3)
Class 1 # pax: total ('000)	-6.55*	-3.50*	-2.86
	[3.61]	[1.99]	[2.29]
Class 2 # pax: total ('000)	3.40***	2.91***	2.98**
	[0.97]	[0.93]	[1.30]
Class 3 # pax: total ('000)	6.48***	4.54***	5.17***
	[1.18]	[0.88]	[0.64]
Class 4 # pax: total ('000)	2.40***	1.95***	1.32*
	[0.81]	[0.62]	[0.70]
Class 5 # pax: total ('000)	11.2***	11.0***	11.0***
	[0.92]	[1.24]	[1.23]
Class 1 # pax: total ('000) # Incentives to airlines (EUR) per pax	0.24		
	[0.50]		
Class 2 # pax: total ('000) # Incentives to airlines (EUR) per pax	-0.31		
	[0.54]		
Class 3 # pax: total ('000) # Incentives to airlines (EUR) per pax	-0.64**		
	[0.26]		
Class 4 # pax: total ('000) # Incentives to airlines (EUR) per pax	-0.56***		
	[0.12]		
Class 5 # pax: total ('000) # Incentives to airlines (EUR) per pax	-0.63**		
	[0.31]		
Class 1 # pax: total ('000) # Operating aid (EUR) per pax		0.17	
		[0.19]	
Class 2 # pax: total ('000) # Operating aid (EUR) per pax		0.13	
		[0.095]	
Class 3 # pax: total ('000) # Operating aid (EUR) per pax		-0.37***	
		[0.065]	

Table 7.11. Regressions on OFG (2010-2018), including interactions of linear variables with passengers and class

Variables	OFG (1)	OFG (2)	OFG (3)
Class 4 # pax: total ('000) # Operating aid (EUR) per pax		-0.56***	
		[0.12]	
Class 5 # pax: total ('000) # Operating aid (EUR) per pax		0	
		[.]	
Class 1 # pax: total ('000) # Investment aid (EUR) per pax			-0.16
			[0.46]
Class 2 # pax: total ('000) # Investment aid (EUR) per pax			-0.14
			[0.21]
Class 3 # pax: total ('000) # Investment aid (EUR) per pax			0.47***
			[0.14]
Class 4 # pax: total ('000) # Investment aid (EUR) per pax			-0.042
			[0.045]
Class 5 # pax: total ('000) # Investment aid (EUR) per pax			0
			[.]
Constant	-237008.1*	-194,542.6	-211,702.2
	[120,224.1]	[142,545.1]	[139,785.2]
Fixed effects	yes	yes	yes
Clustered SE	yes	yes	yes
Class-specific year trends	yes	yes	yes
Control for aid per pax and incentives per pax	yes	yes	yes
Observations	423	423	423
F	74	565	3,368

*Source: Team based on sample data. * (p<0.10), ** (p<0.05), *** (p<0.01). Standard errors in parentheses.*

Our results suggest that for the larger classes of airports (classes 3-5), an increase in the level of incentives paid to airlines, significantly decreases the marginal impact of passengers on profitability. In addition, an increase in operating aid per passenger decreases the marginal effect of passengers on OFG a result significant only for classes 3 and 4.[108] Finally, when considering interactions with investment aid per passenger, the positive effect of passengers on profitability

[108] Please note that, in line with the Aviation Guidelines, airports in class 5 are not entitled to receive operating aid.

further significantly increases with higher levels of investment aid (though the effect is significant only for class 3).

Annex C elaborates on these results by providing the net predicted impact of passengers on OFG for the respective models considered.

7.3 CONCLUSIONS

The two interrelated questions of task 4 are: 1) whether the number of passengers is relevant and sufficient to establish the need of operating aid; and 2) whether the thresholds retained in the Aviation Guidelines to determine operating aid intensity are appropriate and, if not, whether a different categorisation should be adopted.

The analysis provided in this Study shows that passengers are certainly important for airports' profitability. Differently from section 6, the analysis in this section focuses on historical data between 2015 and 2018, as predicted measures of profitability for 2019-2024 are more speculative, as they are based on expectations.

The existing literature, as presented in section 3, shows that passengers are an important determinant of airports' profitability. Our findings confirm this result. In our sample of 67 airports, we observe a very strong, positive correlation between an airport's traffic level and its profitability as measured by OFG (as well as other proxies). This correlation is larger, the larger the size of the airport in terms of traffic.

Moreover, this correlation persists even after controlling for other factors that appear to be important determinants of airports' profitability. In particular, in our econometric and cluster analysis, the share of LCC passengers as well as incentives paid to airlines seem to decrease profitability, even though this is not true for all passenger levels. Furthermore, local conditions seem also to play an important role: airports in richer and better-connected regions are more profitable. These results are reinforced by findings from the literature that show that other market characteristics that we could not control, such as market power and congestion, regulation of prices, negotiation power with respect to air carriers; and the type of traffic that the airport is attracting are all very important characteristics.

Therefore, if the question is whether the categorisation of airports by passengers is relevant to establish the need of aid, then the overall answer is yes. However, our empirical analysis also clearly shows that classes based on passengers, although being reasonable, are potentially non-sufficient for defining the need of operating aid. Indeed, consistent with results from task 3 (presented in section 6), both the extent and persistency of needs are highly heterogeneous across current categorisation groups. This is confirmed by our descriptive analysis, as well as the cluster analysis and the regression results, showing large heterogeneity on the role of passengers for profitability across classes.

In order to more carefully analyse these patterns and, in particular, to verify whether categorisations based on passengers are able to sufficiently explain airports financial viability, we confront them with a different categorisation based on profitability itself. By means of a cluster analysis, we identify four main clusters of airports based on OFG. The underlying idea is understanding whether (i) within each clusters of profitability, airports are homogenous in terms of passengers and (ii) the five passengers' classes likely to be associated to each cluster of profitability are those used by the Aviation Guidelines (point 118) to define the ability of airports to cover operating costs. When we compare these profitability clusters with the five-classes based on passengers, we do see that they overlap to a certain extent. However, we also identify quite some heterogeneity within and between classes in the relationship between traffic and profitability.

A first important point coming out of this preliminary analysis is that the finer categorisation of airports into five classes – as proposed by the Commission in order to better understand performance dynamics – seems more appropriate than the categorisation into only three classes initially retained in the Aviation Guidelines in 2014 in order to establish the maximum permitted operating aid intensity. The analysis strongly suggests that there is a clear cut-off at 200,000 passengers below which is very unlikely for an airport to be financially viable. Moreover, airports in class 2 with traffic between 200.001 and 500,000 passengers seem also to be more similar (and less profitable) than airports with traffic between 500,001 and 700,000 passengers: for traffic levels between 200,001 and 500,000 passengers there is a similar fraction of airports with a positive OFG between 2015 and 2018 (around 50%), while all larger airports in the same class have a positive OFG. However, this result relies only on a descriptive analysis

Therefore, to perform our empirical analysis we continue to focus on the five-classes, which seem to be appropriate. We find significant differences in profitability between class 1 and class 2 airports (which until 2017 were categorised together in terms of permitted aid intensity, as airports below 700,000 passengers) as well as between class 3 and class 4 (which, in terms of permitted aid intensity, are still categorised together as airports with a number of passengers between 700,000 and 3 million).

However, even adopting this more fine-grained categorisation, we still identify substantial within-class heterogeneity. Specifically, the small airports (classes 1 and 2) tend indeed to be unprofitable but there are large differences. The smallest one (class 1) never manage to be profitable. In this sense, for this airports' class, the number of passengers seems to be a sufficient indicator of profitability. A specific set of aid rules is thus empirically fully justified for this finer class. Conclusions from section 6 raise also the question on whether a temporary aid measure would ever be sufficient for these airports to recover their financial equilibrium. Among the small airports within class 2, some are also unprofitable. Yet some others manage to break even. Other factors such as high incentives to airlines, and low share of LCC passengers help explaining why some airports in class 2 manage to become profitable. Therefore, for class 2, the number of passengers does not seem to be a sufficient statistic to establish the need of operating aid.

Most of the mid-sized airports (class 3 and class 4) are profitable (they are all expected to be so by 2024, but not so between 2015 and 2018 which is the period considered in this section). Nonetheless, also among them we observe significant differences. On average, class 3 airports are less likely to be profitable than class 4 airports. In this sense, the number of passengers seems to give again a first reasonable indication of airports' financial viability. Yet, in both classes, some airports are unprofitable. Class 3 airports are unprofitable when located in less-favourable areas and when they have a high share of LCC passengers. Class 4 airports that are more unprofitable, tend also to have a high share of LCC passengers. Therefore, looking at these two classes, the number of passengers alone also does not seem to be sufficient to establish the need of operating aid. However, this seems to be less relevant than for smaller classes, as most of these airports at least break even and will reach equilibrium (See task 3). Finally, very large airports (above 3 million passengers per year) are always profitable. Hence, the number of passengers seems to be enough to identify their need for operating aid.

A final remark is also warranted. At a more general level, it seems that the role of passengers for profitability is often significantly mediated by other factors. Specifically, for very-small airports (class 1), passengers reduce on average profitability. For these airports, we even see that passengers – especially LCC passengers – reduce profitability. This is however not true for those airports with a very low share of LCC passengers. In general, an increase in the level of incentives paid to airlines, is associated with a significantly lower marginal impact of passengers on profitability. Moreover, looking at the effect of aid, an increase in operating aid per passenger is associated with a significantly lower marginal effect of passengers on profitability.

Overall, we believe that the finer five-class categorisation based on passengers' traffic better reflects the profitability and hence the financial needs of airports than the narrower categorisation to which the Aviation Guidelines in 2014 initially linked the variation of aid intensity. Yet, we still see room for improvements. Focusing on the smaller airports (class 1 and 2), which are more likely to need financial aid even after the transitional period, we believe that other factors, together with passengers' volume, help better predict the need of financial aid and the aid measure to be adopted. The distribution of revenues across airlines, the share of revenues coming from LCC, the amount of incentives the airport uses to pay to airlines provide useful insight on the self-sustainability of airports and help to forecast the airports' financial performance. The qualitative evidence and the literature review suggest that when most of the traffic comes from LCCs and through incentives, the airports' growth is not sustainable in the long term. Incentives could indeed be offered to support routes that are unprofitable based on a competitive selection of carriers and not on direct negotiations under threats of the airline leaving or to steal traffic from competitors. These factors are found to be relevant in a framework aimed at providing adequate and effective financial support to the operating activities of regional airports. However, since these factors are also at least in part affected by the strategical choices of airports' themselves, they may be used to condition aid upon and be less suitable to define a different categorisation of aid intensity.

ANNEX A. LITERATURE REVIEW

Table A.1 Table of main findings in the literature

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Airports as Drivers of Economic Success in Peripheral Regions (Falcidieno, M., et al.)	336 regions (NUTS2 or NUTS3) in Europe; additional 3 case studies in western Greece, central Finland and northwest Italy	1990-2010	1) For some remote regions, airports with enough scheduled flights are crucial for economic development; in these cases, the bottleneck is not infrastructure but the lack of scheduled flights to relevant destinations. 2) It is better to use a larger airport in a neighbouring region than to develop an airport on its own (if within three hours). 3) In core regions, only the reverse is true: airport activity does not cause regional growth, but regional growth causes airport activity.	GDP, employment, labour productivity	Panel causality test, regression analysis based on time series, case studies

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Air transportation and regional growth: which way does the causality run (Mukkala, K. & Tervo, H.)	86 regions and 13 countries in Western Europe; the countries with the most airports data were Germany, Spain, Italy and the U.K.	1991-2010	1) Air transportation is more than a facilitator in remote regions. In these regions, in addition to regional growth causing airport activity, air activity appears to boost regional development. 2) Supply-side effects are important for distant regions. 3) In core regions, only the reverse is true: airport activity does not cause regional growth, but regional growth causes airport activity.	Regional development was measured by growth in employment and growth in purchasing power corrected for real GDP. Airport activity was measured by number of commercial air passengers. Accessibility variable was defined as a weighted average travel time to other European regions, taking into account the best combination of air, rail and road.	Heterogeneous Granger causality analysis
Air transport services in remote regions (Bråthen, S.)	Focused on Norway but also looks at France, Spain, Portugal, Scotland, Ireland, Sweden, Spain and Germany	1999-2011	1) Unclear whether decentralized or centralized administration of air transport PSOs provides better access to remote areas.	Discussion paper provided an overview of public service obligation (PSO) routes in remote areas of Europe. (Norway has the largest number of PSOs at 61. Spain, Portugal and Scotland are on the lower end with 10-12 each).	Descriptive analysis

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
			2) Airlines should consider route development activities together with other local authorities so as to cooperate with road and railway developers because these alternatives are the main drivers of "leakage" from small airports. 3) Even if subsidy levels are significant, the overall positive socio-economic effects may outweigh the cost of aid.		
EU-funded airport infrastructures: poor value for money (Report from the European Court of Auditors)	20 airports in 5 countries (Estonia, Greece, Spain, Italy, Poland)	2000-06 and 2007-13	1) Too many airports (which were often in close proximity to each other) were given outsized funding. 2) 7 of the 20 airports examined are not profitable and risk closure unless they receive continuous public financial support. (This is particularly the case with small regional airports with <100 thousand passengers per year).	The report evaluates effectiveness of airport infrastructure spending, on the case by case basis	Case study and audit: the 20 airports received a total EU funding of EUR 666M through the European Regional Development Fund ("ERDF") and the Cohesion Fund ("CF").

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
			3) EU funding is not well coordinated by the Member States and is insufficiently supervised by the Commission, leading to over-capacity and poor value for money results.		
Small regional airport sustainability: Lessons from benchmarking (Adler, N., et al.)	85 airports in 7 countries (Scotland, Norway, UK, Austria, France, Germany, Italy). Annual passengers served at each airport ranged from 3000 to 1.6 M.	2002-2009	1) Small airports operating within a network of airports appear to have a significant negative effect on managerial efficiency, in comparison to standalone airports. 2) Broadly, a 10% reduction in cost efficiency has occurred over the last decade, mostly due to large increases in costs without matching increases in revenues.	Inputs were staff costs, operating costs, runway length. Outputs were number of passengers, commercial air traffic movements (ATM), cargo, non-aeronautical revenue. Managerial efficiency focused on runways, ATM, passengers, and cargo as non-discretionary variables over which airport managers have little to no influence.	Data development analysis ("DEA")

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Air Passenger Transport and Regional Development: Cause and Effect in Europe (Van de Vijver, E., et al.)	European NUTS 2 regions (112 regions total)	2002-2011	1) Causality patterns between air transport and employment are geographically heterogenous and sometimes absent. Accessibility is necessary but not sufficient for regional growth. 2) The influence of air transport on employment is more marked than the influence of employment on air transport. 3) Causality from air transport to employment is stronger for the services sector but also occurs in the manufacturing sector	1) Air passenger transport (passenger volume) versus total employment 2) Air passenger transport versus employment in manufacturing and service sectors. The above were analysed in both directions so as to simultaneously measure the two-way influences for causality.	Heterogeneous Granger causality analysis
The influence of fleet mix, ownership and LCCs on airports' technical and environmental efficiency (Martini, G., et al)	33 non-hub Italian airports	2005-2008	1) The higher the stake of public local authorities in the airports' ownership structure, the higher their technical/environmental efficiency 2) There was no significance to the presences of LCCs on airport efficiency.	Airports efficiency outputs focus on yearly number of workload unit ("WLU") movements and ATMs. Factors affecting airport efficiency include fleet mix, airports' ownership structure, size, and presence of LCCs.	Directional distance function ("DDF") model; Simar and Wilson bootstrapping

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
			3) Larger-scale airport reach higher efficiency scores due to scale economies.		
Germany's regional airports under political and economic pressure (Heymann, E. & Karollus, A.)	German regional airports that serviced between 200 thousand to 3 million passengers per year e.g. Bremen, Dortmund, Dresden, Leipzig.	2005-2014	1) With few exceptions, regional airports have been in the red for about the past ten years. Low traffic volumes meet high overheads. 2) In the future, air traffic in Germany is likely to increase primarily at large airports as well, partly because airlines prefer them and partly because they benefit from ongoing migration to conurbations. 3) Of two or more regional airports are located close to one another, their catchment areas will overlap, and they will target the same customers which would trigger cutthroat competition or cannibalisation effects.	Several airports are evaluated on case by case basis	Compared passenger volume at German regional airports from 2005-2014 (against volume at major German airports; also broke out volume at the largest 4 regional airports)

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Small is beautiful? The impact of economic crisis, low cost carriers and size on efficiency of Spanish airports (Coto-Millan, P., et al.)	35 non-military Spanish airports, of which 21 are small/regional airports	2009-2011	1) Airport size has a positive impact on the technical and scale efficiency. Technical efficiency measures the ability to make the best use of available technology. 2) The presence of LCCs has positively affected the scale efficiency of the airports where they operate. Pure efficiency corresponds to technical efficiency once the effects of scale have been eliminated.	Independent variables: airports size, share of LCCs passengers Dependent variables: overall technical efficiency scores, pure technical efficiency scores, scale efficiencies.	DEA and Malmquist index

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
European connectivity: the role played by small airports (Redondi, R, et al.)	75.000 municipalities with an average population of 5000 people in 16 Western European countries (focusing on Norway, Sweden, and Finland). The 280 Western European airports were divided into two groups: those serving <1 million passengers and those serving 1-2 million passengers.	2011	1) Average travel time would increase by 1,5% when closing very small airports and 2,5% when closing small airports. That appears small at a continental European level, but the worsening of accessibility for single countries is much more pronounced. 2) The countries that are most affected by the loss of very small and small airports are those that are already peripheral, such as Finland, Norway and Sweden. 3) Among the 280 airports with <2 M passengers per year, just 50 airports contribute to more than 60% of the connectivity loss at the European level.	Connectivity of municipalities is comprised of three measurements: travel time to reach origin airport, travel time from destination airport to destination municipality. Used to compute an accessibility index ("AI") defined as the population weighted average travel time to all other municipalities.	Computing the quickest travel time necessary to connect each origin municipality to any destination in Europe and to major intercontinental destinations, including access times to the airports and flights times.
InterVISTAS Consulting LTD commissioned by Airports Council International Europe (ACI Europe)	125 EU airports, representing approximately 71% of air traffic in Europe	Report published in 2015	1)Direct employment effect: for airports with<1 million traffic units, each increase of 1000 traffic units increases employment by 1.2 jobs	Employment levels	Direct effect through employment survey of airports

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
			2) Connecting passengers generate 3% less direct jobs than origin/destinations passengers 3) LCC passengers generate 20% less direct jobs than non-LCC passengers		
Operational and financial performance of Italian airport companies: A dynamic graphical model (Abbruzzo et al.)	Ten Italian airport companies (13 airports)	2008-2014	1) Increasing jointly the number of movements with flights that would attract a high number of passengers may improve both profitability and revenues 2) Effect of LCCs has been heterogeneous throughout the sample.	Airport profitability measures, revenues	Penalised RCON(V, E) model, which falls within the class of Gaussian graphical models
Evaluating the multi-period operating efficiency of international airports using data envelopment analysis and the Malmquist productivity index (Ahn and Min)	23 airports around the world, mostly large ones	2006-2011	1) Airport efficiency is not necessarily driven by managerial innovation. 2) Airport efficiency is influenced by external factors such as government policy shifts.	Number of flights, annual passenger throughputs, and annual cargo throughputs	DEA/Malmquist productivity index

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Factors explaining charges in European airports: Competition, market size, private ownership and regulation (Bel and Fageda)	100 airports in Europe, various sizes	2007	1) Competition from other transport modes and nearby airports imposes some discipline on the pricing behaviour of airports. 2) Low-cost carriers and dominant airlines have countervailing power. 3) Private not regulated airports charge higher prices than public or regulated airports.	Aeronautical charge level	Regression analysis
Are airports engines of economic development? A dynamic panel data approach (Bilotkach)	All primary airports in the USA	1993-2009	1) Number of destinations served with non-stop flights has a clearer impact on regional development than traffic level. 2) Passenger traffic volume affects employment and average wage, but not number of establishments.	Employment, average wage, number of businesses in corresponding Metropolitan Statistical Areas (“MSAs”)	Dynamic panel data Generalized Method of Moments

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
			3) At the sample median, connecting a metropolitan statistical area with an extra destination, creates 98 jobs and facilitates the opening of four new businesses. 4) The impact of air travel on regional economic development is influenced by competition on the respective airline markets.		
Regulation, Privatization, and Airport Charges: Panel Data Evidence from European Airports (Bilotkach et al.)	61 European airports, various sizes	1990-2007	1) Single-till regulation generates lower aeronautical charges. 2) Airport privatization leads to lower aeronautical charges. 3) Airports experiencing ex post regulation (i.e., monitoring) have lower aeronautical charges 4) Price-cap regulation does not significantly affect charges	Aeronautical charges level	Dynamic panel data Generalized Method of Moments

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Airports and urban growth: evidence from a quasi-natural policy experiment (Blonigen and Cristea)	300 US metro areas	1969, 1977, 1991	1) Air service has a significant positive effect on regional growth 2) The magnitude of the effects differs by MSA size and industrial specialization	Population, income, and employment growth rate	Regression analysis
Competition, vertical relationship and countervailing power in the UK airport industry (Bottasso et al.)	24 UK airports	1996-2008	Lower concentration in an airport's catchment area, higher airlines countervailing power and more intense downstream competition lead to lower aeronautical charges	Aeronautical charges level	Panel data analysis
Ready for Take-off? The Economic Effects of Regional Airport Expansion/Breidenbach	German regional airports	1991-2008	No evidence for spill over effects of airport infrastructure investment on regional economy	Regional GDP growth rates	Difference-in-differences identification strategy
Airline traffic and urban economic development Brueckner	Major US metropolitan areas	1996	1) Ten per cent increase in passenger enplanements leads approximately to a 1 per cent increase in employment in service-related industries.	Employment (MSA level)	Regression analysis using instrumental variable technique (2SLS)

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
			2) Airline traffic has no effect on manufacturing and other goods-related employment		
Airfreight transport and economic development: an examination of causality/ Button and Yuan	32 US MSAs, mostly larger airports	1990-2009	Airfreight transport is a positive driver for local economic development (focus is on direction of causality).	MSA level employment and personal income	Granger Causality Test
The relationship between airport performance and privatisation policy: a nonparametric metafrontier approach (Chen et al.)	Twenty-four large airports in Europe and Asia-Pacific	2001-2013	1) Privately owned airports have better technical efficiency than public ones. 2) Public airports in the Asia-Pacific area have the lowest techno-economic efficiency.	Various conventional input and output metrics	Technological gap ratios calculated on the basis of DEA scores
Did the EU Airport Charges Directive lead to lower aeronautical charges (Conti et al.)	EU airports serving 2-20 million passengers per annum	2008-2017	Transposition of the Airport Charges Directive into national legislation has led to a statistically significant reduction in the level of airport charges, but only after a few years	Aeronautical charges level	Regression analysis using difference-in-differences methodology

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Incentive schemes on airport charges — Theoretical analysis and empirical evidence from German airports (Fichert and Klophaus)	Nine regional German airports	1999-2009	No clear generalisations can be drawn from the analysis of incentive schemes offered at the airports under investigation	Number of routes, load factors, airport market shares	Descriptive
Airport delays and metropolitan employment (Bilotkach and Lakew)	Major US MSAs	2004-2012	1) Service-sector employment is less sensitive to air traffic than other studies suggested. 2) Delays have a negative effect on employment. 3) A 10 percent increase in the number of delayed flights leads to up to a 0.15 percent decrease in total and service-sector employment, a 0.47 percent decline in leisure and hospitality employment, and a 0.7 percent reduction in the employment level of goods-producing jobs	Employment	Panel data analysis with instrumental variables

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Total factor productivity analysis of the UK airport industry: A Hicks-Moorsteen index method (See and Li)	24 UK Airports, various sizes	2001-2009	1) The productivity of the UK airport industry increased by 0.32 per cent per year from 2001 to 2009. 2) Efficiency change contributed the most to the TFP growth. 3) Private airports tend to be more productive than airports under public and mixed ownership.	Traffic level, number of movements	Hicks-Moorsteen index method
Airports and urban sectoral employment (Sheard)	Major US MSAs	2007	1) Airport size has a positive effect on the employment share of tradable services, but no measurable effect on manufacturing or most non-tradable sectors. 2) The effect of airport size on overall local employment is practically zero. 3) The implied elasticity of tradable-service employment with respect to airport size is 0.22.	Employment	Regression analysis with instrumental variables

Study Title & Author(s)	Airports Studied	Years Studied	Finding	Indicator of Economic Performance	Methodology
Greek airports: Efficiency measurement and analysis of determinants (Tsekeris)	A sample of Greek airports, various sizes	2007	The analysis shows the importance of seasonality in demand on the performance of the airports, and the effect of location, size and operating characteristics on their technical efficiency, signifying peculiarities of the Greek airport system.	Outputs: passengers, cargo, aircraft movements	Data Envelopment Analysis

Figures (reference to section 3.2.6)

The figures below document a turning of LCCs (respectively Ryanair and easyJet) from smaller airports to primary airports.

Figure A.1 Evidence of LCCs business model dynamics: the figure reproduces Fig. 4 in (Dziedzic, M. & Warnock-Smith, D., 2016)

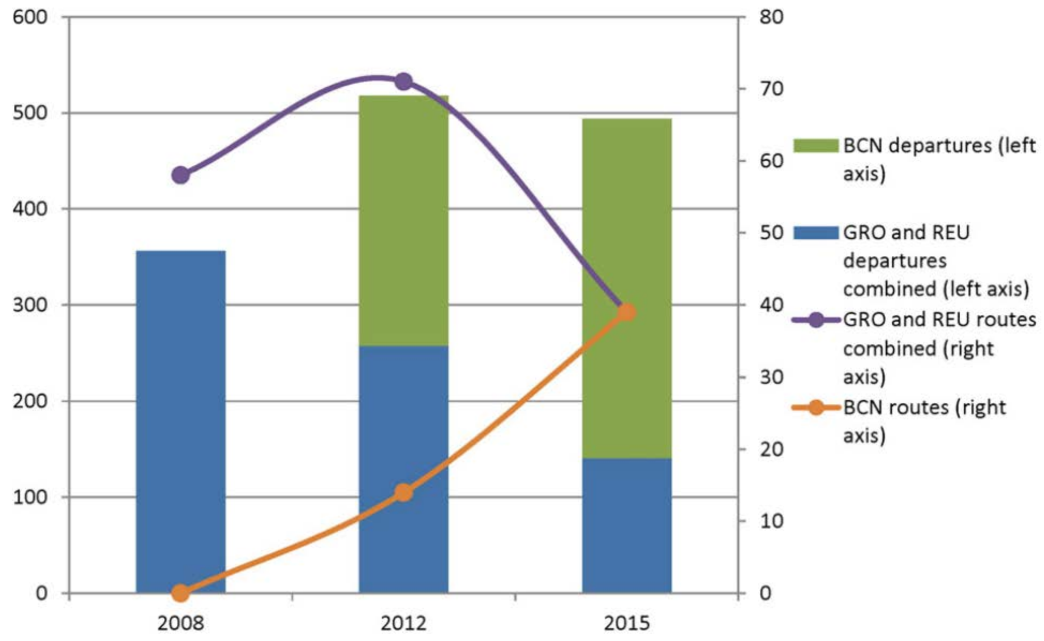


Fig. 4. Ryanair routes from airports serving Barcelona Source: OAG database.

Source: (Dziedzic, M. & Warnock-Smith, D., 2016), p. 23. Note: GRO and REU are Girona and Reus airports (secondary airports), while BCN is Barcelona airport (primary airport).

With reference to the figure below, the authors report that “Established in 1999, Liverpool was one of the first easyJet bases. Until 2008, the airport had been developing especially owing to low-fare services. Then, Manchester Airport, the primary gateway for the region. introduced a new charging system. The changes included reductions in landing fees (−38%) and more convenient off-peak charges, which naturally attracted LCCs at the cost of [Liverpool]” (Dziedzic, M. & Warnock-Smith, D., 2016), p. 23.

Figure A.2 Evidence of LCCs business model dynamics: the figure reproduces Fig. 5 in (Dziedzic, M. & Warnock-Smith, D., 2016)

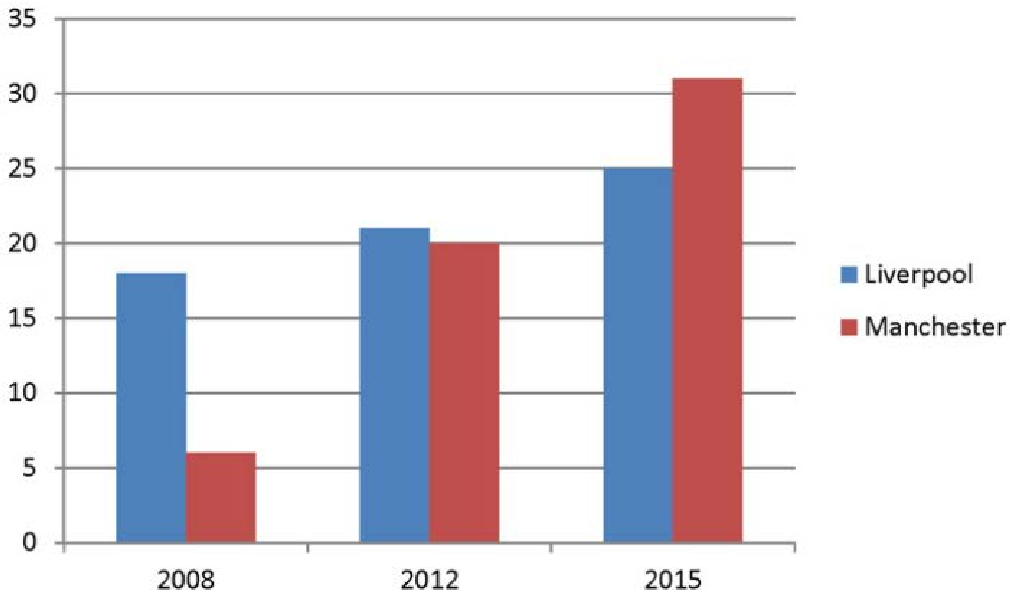


Fig. 5. Number of easyJet routes served from MAN and LPL.

Source: (Dziedzic, M. & Warnock-Smith, D., 2016), p. 23. Note: Liverpool is a secondary airport, while Manchester is a primary airport.

References

Abbruzzo, A., V. Fasone, & R. Scuderi . (2016). Operational and financial performance of Italian airport companies: A dynamic graphical model. *Transport Policy, 52*, 231-237.

ACI Europe. (2016). The Ownership of Europe's Airports.

Adler, N., & Liebert, V. (2014). Joint impact of competition, ownership form and economic regulation airport performance and pricing. *Transportation Research Part A: Policy and Practice*, 92-109.

Adler, N., Ulku, T., Yazhemsky, E. (2013). Small regional airport sustainability: Lessons from benchmarking. *Journal of Air Transport Management, 33*, pp. 22-31.

Ahn, Y-H., & H. Min. (2014). Evaluating the multi-period operating efficiency of international airports using data envelopment analysis and the Malmquist productivity index. *Journal of Air Transport Management, 39*, 12-22.

Albalate, D., G. Bel, & X. Fageda. (2015). Competition and cooperation between high-speed rail and air transportation services in Europe. *Journal of Transport Geography, 42*, 166-174.

Allroggen, F. & Malina, R. (2014). Do the regional growth effects of air transport differ among airports? *Journal of Air Transport Management, Volume 37*, pp. 1-4.

Aschauer, D. (1989). Is public expenditure productive? *Journal of Monetary Economics, 23*, 177-200.

Barbot, C. (2006). Low-cost airlines, secondary airports, and state aid: An economic assessment of the Ryanair–Charleroi Airport agreement. *Journal of Air Transport Management, 12(4)*, 197-203.

Basso, L. and A. Zhang . (2008). Sequential peak-load pricing: the case of airports and airlines. *Canadian Journal of Economics, 41*, 1087-1119.

Behrens, C., & E. Pels. (2012). Intermodal competition in the London-Paris passenger market: High-Speed Rail and air transport. *Journal of Urban Economics. 71(3)*, 278-288.

Bel, G. & Fageda, X. (2009). Preventing competition because of 'solidarity': rhetoric and reality of airport investments in Spain. *Applied Economics*, 41(22).

Bel, G. & X. Fageda . (2010). Factors explaining charges in European airports: Competition, market size, private ownership and regulation. *Journal of Regulatory Economics, 37(2)*, 142-161.

Bel, G.; Fageda, X. (2008). Getting there fast: globalization, intercontinental flights and location of headquarters. *Journal of Economic Geography, 8(4)*, pp. 471-495.

Bilotkach, V. (2015). Are airports engines of economic development? A dynamic panel data approach. *Urban Studies, 52 (9)*, 1577-1593.

Bilotkach, V. (2018). Political economy of infrastructure investment. Evidence from the economic stimulus airport grants. *Economics of Transportation, 13*, 27-35.

Bilotkach, V., & A. Polk. (2013). The Assessment of Market Power of Hub Airports. *Transport Policy, 29*, 29-37.

Bilotkach, V., J.A. Clougherty, J. Mueller, & A. Zhang. (2012). Regulation, Privatization, and Airport Charges: Panel Data Evidence from European Airports. *Journal of Regulatory Economics, 42*, 73-94.

Bilotkach, V., X. Fageda, & R. Flores-Fillol. (2010). Scheduled service versus personal transportation: The role of distance. *Regional Science and Urban Economics, 40(1)*, 60-72.

Blonigen, B., & A. Cristea. (2012). Airports and urban growth: evidence from a quasi-natural policy experiment,. *NBER Working Paper No. 18278.*

Bottasso, A., M. Bruno, M. Conti, & C. Piga . (2017). Competition, vertical relationship and countervailing power in the UK airport industry. *Journal of Regulatory Economics, 52*, 37-62.

Bråthen, S. . (2011). Air transport services in remote regions. *ITF Discussion Paper No. 2011-13 s.l., s.n.*

Bråthen, S., Johansen, S. & Lian, J. I. . (2006). An inquiry into the link between air transport and employment in Norway. *Proceedings from the European Transport Conference, Strasbourg.*

Breidenbach, P. (2015). Ready for Take-off? The Economic Effects of Regional Airport Expansion. *Ruhr Economic Papers 549*.

Brueckner, J. (2002). Airport congestion when carriers have market power. *American Economic Review, 92 (5)*, 1357-1375.

Brueckner, J. (2003). Airline traffic and urban economic development. *Urban Studies, 40,*, 1455-1469.

Button, K., & J. Yuan. (2013). Airfreight transport and economic development: an examination of causality. . *Urban Studies, 50,*, 329-340.

Cadot, O., L.H. Roeller, & A. Stephan . (2006). Contribution to productivity or pork barrel? The two faces of infrastructure investment. *Journal of Public Economics, 90*, 1133-1153.

Castells, A., & A. Sole-Olle . (2005). The regional allocation of infrastructure investment: the role of equity, efficiency, and political factors. *European Economic Review, 49*, 1165-1205.

Chen, Y-H., P-L. Lai, & P. Piboonrungroj . (2017). The relationship between airport performance and privatisation policy: a nonparametric metafrontier approach. . *Journal of Transport Geography, 62*, 229-235.

Choo, Y. Y. & Oum, T. H. . (2013). Impacts of low-cost carrier services on efficiency of the major U.S. airports. *Journal of Air Transport Management, Volume 33*, pp. 60-67.

Conti, M., A.R. Ferrara, & M. Ferraresi . (2019). Did the EU Airport Charges Directive lead to lower aeronautical charges? Empirical evidence from a diff-in-diff research design. *Economics of Transportation, 17*, 24-39.

Cooper, A. & Smith, P. (2005). The economic Catalytic Effects of Air Transport in Europe. *EUROCONTROL*.

Coto-Millan, P., Casares-Hontanon, P., Inglada, V. & Agueros, M. . (2014.). Small is beautiful? The impact of economic crisis, low cost carriers, and size on efficiency in Spanish airports (2009-2011). *Journal of Air Transport Management, Volume 40*, pp. 34-41.

Coto-Millán, P., Casares-Hontañón, P., Inglada, V., Agüeros, M., Pesquera, M.A. & Badiola, A. (2014). Small is beautiful? The impact of economic crisis, low cost carriers, and size on efficiency in Spanish airports (2009-2011). *Journal of Air Transport Management, Volume 40*, pp. 34-41.

Czerny, A. (2006). Price-cap regulation of airports: Single-till versus dual-till. *Journal of Regulatory Economics, 30*, 85-97.

Dziedzic, M. & Warnock-Smith, D. (2016). The role of secondary airports for today's low-cost carrier business models: The European case. *Research in transportation business & management, 21*, pp. 19-32.

EEA. (2017). Aviation and shipping - impacts on Europe's environment. . *EEA Report, No 22/2017*.

European Commission . (2014). Guidelines on State aid to airports and airlines. *Communication 2014/C 99/03*.

Fageda, X., A. Suárez-Alemán, T. Serebrisky, & R. Fioravanti. (2018). Air connectivity in remote regions: A comprehensive review of existing transport policies worldwide. *Journal of Air Transport Management, 66*, 65-75.

Fageda, X., A. Suárez-Alemán, T. Serebrisky, & R. Fioravanti. (2018). Air connectivity in remote regions: A comprehensive review of existing transport policies worldwide. *Journal of Air Transport Management, 66*, 65-75.

Falcidieno, M. L. & al., e. (2012). *ADES - Airports as Drivers of Economic Success in Peripheral Regions.* ESPON & University of Genoa.

Fichert, F., & R. Klophaus. (2011). Incentive schemes on airport charges — Theoretical analysis and empirical evidence from German airports. *Research in Transportation Business & Management, 1(1)*, 71-79.

Forsyth, P. (2007). Estimating the Costs and Benefits of Regional Airport Subsidies: A Computable General Equilibrium Approach. *Monash University Working Paper.*

Forsyth, P., D.W. Gillen, A. Knorr, O.G. Mayer, H.-M. Niemeier, and D. Starkie, eds. (2004). The economic regulation of airports: recent developments in Australasia, North America, and Europe. *Ashgate, Burlington, VT*.

Fridstrom, L. & R. Elvik. (1997). The barely revealed preference behind road investment priorities. *Public Choice, 92*, 145-168.

Fu, X., W. Homsombat, & T.H. Oum . (2011). Airport–airline vertical relationships, their effects and regulatory policy implications. *Journal of Air Transport Management, 17(6)*, 347-353.

Gillen, D. (2011). The evolution of airport ownership and governance. *Journal of Air Transport Management, 17(1)*, 3-13.

Gössling, S., Fichert, F. & Forsyth, P. (2017). Subsidie in aviation. *Sustainability, 9(8)*, p. 1295.

Graham, A. . (2009). *Managing Airports: an International Perspective, 3rd Edition.* Elsevier.

Graham, A. & Dennis, N. (2010). The impact of low cost airline operations to Malta. *Journal of Air Transport Management, 16(3)*, pp. 127-136.

Ha, H., & Y. Park . (2006). Analysis of the impact of high-speed railroad service on air transport demand. *Transportation Research Part E, 42(2)*, 95-104.

Heymann, E. & Karollus, A. (2015). Germany's regional airports under political and economic pressure. *Frankfurt: Deutsche Bank Research*.

Huderek-Glapska, S. & Nowak, H. . (2016). Airport and low-cost carrier business relationship management as a key factor for airport continuity: The evidence from Poland. *Research in Transportation Business & Management, Volume 21*, pp. 44-53.

InterVISTAS. (2015). Economic Impact of European Airports. *ACI EUROPE*.

ITF . (2014). Expanding Airport Capacity in Large Urban Areas. *Roundtable Report 153*.

Kasarda, J.D., & J.D. . (2005). Green Air cargo as an economic development engine: a note on opportunities and constraints. *Journal of Air Transport Management, 11 (6)*, 459-462.

Kemmerling, A., & A. Stephan . (2002). The contribution of local public infrastructure to private productivity and its political economy: evidence from a panel of large German cities. *Public Choice, 113*, 403-424.

Kemmerling, A., & A. Stephan . (2008). Determinants and productivity of regional transport investment in Europe. .

Lakew, PA, & V. Bilotkach . (2018). Airport delays and metropolitan employment. *Journal of Regional Science, 58*, 424– 450.

Laurino, A. & Beria, P. (2014). Low-cost carriers and secondary airports: Three experiences from Italy. *Journal of Destination Marketing & Management 3(3)*, pp. 180-191.

Littlechild, S. . (2018). Economic regulation of privatised airports: Some lessons from UK experience. *Transportation Research Part A: Policy and Practice, 114*, 100-114.

Malina, R., Albers, S. & Kroll, N. . (2012). Airport incentive programmes: a European perspective. *Transport Reviews, 32(4)*, pp. 435-453.

Martini, G., Manello, A. & Scotti, D. . (2012). The influence of fleet mix, ownership and LCCs on airports' technical/environmental efficiency. . *Transportation Research, 50(Part E)*, pp. 37-52.

Merkert, R. & Mangia, L. . (2014). Efficiency of Italian and Norwegian airports: A matter of management or of the level of competition in remote regions? *Transportation Research, Volume 62*, pp. 30-38.

Mukkala, K. & Tervo, H. . (2013). Air transportation and regional growth: which way does the causality run? *Environment and Planning A, 45(6)*, pp. 1508-1520.

Núñez-Sánchez, R. . (2015). Regional public support to airlines and airports: An unsolved puzzle. *Transportation Research Part E: Logistics and Transportation Review, 76,*, 93-107.

Oster, C.V., B.M. Rubin, & J.S. Strong . (1997). Economic impacts of transportation investments: the case of Federal Express. . *Transportation Journal, 37 (2)*, 34-44.

Oum, T. H., Yan, J. & Yu, C. . (2008). Ownership forms metter for airport efficiency: A stochastic frontier investigation of worldwide airports. *Journal of Urban Economics, 64(2)*, pp. 422-435.

Pagliari, R., & A. Graham . (2019). An exploratory analysis of the effects of ownership change on airport competition. *Transport Policy, 78*, 76-85.

Parker, D. . (1999). The Performance of BAA before and after Privatisation: A DEA Study. *Journal of Transport Economics and Policy, 33(2)*, pp. 133-45.

Pavlyuk, D. . (2010). Multi-tier spatial stochastic frontier model for competition and cooperation of European airports. *Transport and Telecommunication, 11(3)*, pp. 57-66.

Pels, E., P. Nijkamp, & P. Rietveld . (2003). Inefficiencies and scale economies of European airport operations. . *Transportation Research Part E: Logistics and Transportation Review, 39(5)*, 341-361.

Percoco, M. . (2010). Airport Activity and Local Development: Evidence from Italy. *Urban Studies 47(11)*, pp. 2427-2443.

PWC. (2014). Connectivity and growth: Directions of travel for airport investments. .

Redondi, R., Malighetti, P. & Paleari, S. . (2013). European connectivity: the role played by small airports. *Journal of Transport Geography 29*, pp. 86-94.

Rey, B., Myro, R. L. & Galera, A. . (2011). Effect of low-cost airlines on tourism in Spain. A dynamic panel data model. . *Journal of Air Transport Management, 17(3)*, pp. 163-167.

Schlenker, W. & Walker, W. R. . (2015). Airports, Air Pollution, and Contemporaneous Health. *Reveiw of Economic Studies, 83(2)*, pp. 768-809.

See, K.F., & F. Li . (2015). Total factor productivity analysis of the UK airport industry: A Hicks-Moorsteen index method. *Journal of Air Transport Management, 43*, 1-10.

See, K.F., & Li, F. (2015). Total factor productivity analysis of the UK airport industry: A Hicks-Moorsteen index method. *Journal of Air Transport Management, 43*, 1-10.

Sheard, N. . (2014). Airports and urban sectoral employment. *Journal of Urban Economics, 80*, 133-152.

Special report of the European Court of Auditors . (2014). EU-funded airport infrastructures: poor value for money., s.l.: s.n.

Starkie, D. . (2004). Testing the regulatory model: The expansion of Stansted airport. *Fiscal Studies, 25*, 389-413.

Takebayashi, M. . (2014). The future relations between air and rail transport in an island country. . *Transportation Research, Volume 62*, pp. 20-29.

Tapiador, F., Mateos, A. & Martí-Henneberg, J. (2008). The geographical efficiency of Spain's regional airports: A quantitative analysis. *Journal of Air Transport Management, 14(4)*, pp. 205-212.

Thelle, M.H., & M. la Cour Sonne . (2018). Airport competition in Europe. *Journal of Air Transport Management, 67*, 232-240.

Tsekeris, T. . (2010). Greek Airports: Efficiency Measurement and Analysis of Determinants. *Athens: Centre for Planning and Economic Research*.

Tsekeris, T. . (2011). Greek airports: Efficiency measurement and analysis of determinants. *Journal of Air Transport Management, 17(2)*, 140-142.

Tsekeris, T. (2011). Greek airports: Efficiency measurement and analysis of determinants. *Journal of Air Transport Management, 17(2)*, 140-142.

Tsui, W.H.K., A. Gilbey, & H.O. Balli . (2014). Estimating airport efficiency of New Zealand airports. *Journal of Air Transport Management, 35*, 78-86.

Ülkü, T. (2014). *Empirical analyses of airport efficiency and costs: Small regional airports and airport groups in Europe.* Humboldt Universität zu Berlin, Wirtschaftswissenschaftliche Fakultät.

Van de Vijver, E., Derudder, B. & Witlox, F. . (2016). Air Passenger Transport and Regional Development: Cause and Effect in Europe. *Traffic & Transportation, Volume 28*, pp. 143-154.

Van Dender, K. . (2007). Determinants of fares and operating revenues at US airports. *Journal of Urban Economics, 62*, 317-336.

Viscusi, W.K., J.M. Vernon, & J.E. Harrington. (2005). *Economics of Regulation and Antitrust, Fourth Edition.* MIT Press.

Voltes-Dorta, A. & Pagliari. (2012). The impact of recession on airports' cost efficiency. *Transport Policy, Volume 24*, pp. 211-222.

WHO. (2018.). Environmental Noise Guidelines for the European Region.

Wiltshire, J. . (2018). Airport competition: Reality or myth? *Journal of Air Transport Management, 67*, 241-248.

Wittman, M. D. (2014). Public Funding of Airport Incentives: The Efficacy of the Small Community Air Service Development Grant (SCASDG) Program. *MIT Small Community Air Service White Paper No. 4.*

Yang, H. and A. Zhang . (2011). Price-cap regulation of congested airports. *Journal of Regulatory Economics, 39*, 293-312.

Zuidberg, J. . (2017). Exploring the determinants for airport profitability: Traffic characteristics, low-cost carriers, seasonality and cost efficiency. *Transportation Research Part A, Volume 101*, pp. 61-72.

ANNEX B. ADDITIONAL ANALYSES TO SECTION 6

Measurement of the Operating Funding Gap (OFG)

As explained in section 6.1.1, the measurement of OFG in this Study is based on the assumption that SGEI and public remit costs are on average exactly offset by the corresponding compensations, because only 74% of airports out of 68 provided coherent information on this type of costs.

Table B.1 shows the extent to which the assumption holds on average in the sample, for the airports for which the information is verifiable on sample data.

Table B.1 Ratio of SGEI and public remit costs over the corresponding compensations

# of observations	Mean	Std.dev.	5th percentile	Median	95th percentile
74	0.95	0.16	.58	1.00	1

Source: Team based on sample data. The table includes only airport-year observations where compensations (SGEI or public remit) and the relevant costs are both quantified

It is possible to relax this assumption and to test how results change for the airports that provided all the necessary information. For this subsample, Table B.2 compares the results when using the baseline definition of OFG implemented in section 6.2.1 (second column), with those that are obtained when using the exact definition under the Aviation Guidelines (third column). [109] The comparison highlights that there is no change in the evaluation of the outcome.

[109] See section 6.2.1 for reference.

Table B.2 Distribution by class of airports that will have a positive OFG in 2024 among those that provided consistent information on SGEI and public remit costs

Class	Total number of airports	Number of airports in equilibrium based on the assumption that compensations equal costs	Number of airports in equilibrium based on actual data
1	5	1	1
2	16	12	12
3	9	9	9
4	15	15	15
5	5	5	5
Total	50	42	42

Source: Team based on sample data.

Evidence on an alternative definition of airports' funding gap ("AFG")

Some airports pointed out that the OFG as defined in the Aviation Guidelines, which is essentially EBITDA (deflated for the value of operating aid and of compensations for public remit or public service obligations) might not be the best indicator to capture financing needs especially if the aim is to assess funding needs to achieve a sound financial performance in the long run.

Some suggested that basing the eligibility to operating aid on cash flows (i.e. redefining OFG as the operating *financial* gap), rather than on the profit and loss statement, would be more reasonable. Apart from this criticism, which is based on the distinction between accrual- or financial-based approaches, there is a common concern about where to draw the line to circumscribe the scope of operating aid: including or excluding components related to investments and to financing (expenditure or costs).

Common concerns were in fact that the operating aid should also take into account infrastructure investments, as well as the cost of capital to finance operations and investments (allowing to deduct depreciations and financial costs or taking into account the free cash flow after deducting capital expenditure). These claims were generally conveyed together with the idea that small and regional airports need to invest in order to grow their traffic toward the operating breakeven and also to increase efficiency of operations, especially when the airports feel that they have a role in the development of the region.

Many opinions are that the maximum operating aid that airports can access understate their actual financial or funding gap. A relevant point touched in some of these discussions is that investment expenditures are not fully entitled to investment aid under the Aviation Guidelines. In particular, the criticism is that only up to 75% of the costs for investments in the aviation area of business (i.e. for the development of aeronautical revenues) are eligible to investment aid under the Aviation Guidelines.[110] Moreover, no costs related to investments in the non-aviation area of business (for the development of non-aeronautical revenues) are eligible to investment aid under the Aviation Guidelines. The criticism leans on two elements: one is that also investments in the non-aviation lines of business are meant to reach profitability and should be eligible for either investment or operating aid; the other is that all revenue streams – from both non-aviation and aviation activity – are instead fully taken into account when determining the amount of operating needs. The point is that since non-aviation investment is not eligible for aid, then only net profits from non-aviation revenues should concur to reduce the scope for operating aid, i.e. only what is left after covering depreciation and amortization (at least the part which is not eligible for State aid), interests on both aviation and non-aviation loans, and taxes.

Some airports made specific reference to infrastructure maintenance costs that, among capital expenditure, should be eligible for operating aid.

Some airports pointed out that a large share of operating costs and expenditures are a result of regulation, to comply with certification, security and other obligations arising from applicable laws. Airports cannot avoid incurring such costs, that are out of management control, and compliance often requires investments. Some also claimed that individual Member States have room to freely shape this area, leading to distortion of competition among airports from different EU countries, which in principle operate in the same internal market. One airport receiving SGEI yearly compensation to finance infrastructure, security and flight control, highlighted that the compensation it receives is not split between operating and investment costs, and that it has to be deducted entirely from EBITDA when computing the OFG even though it should be used in part to cover capital expenditure.

From an economic point of view, the claim is that the revenue stream from non-aviation activities is the direct return to investment in activities that are not allowed to be supported by public resources while these returns, that should cover capital costs, are instead used to reduce the need of operating aid.

An alternative definition of an airport's funding gap could take into account at least in part this point of view if the objective is to stimulate profitability, which may be mediated by sound investments.

Using Earnings before Interest and Taxes ("EBIT"), instead of EBITDA, would address fully the lack of recognition of investment costs within the scope of operating aid (though still leaving out the cost of financing, that is interests on loans for investments in the aviation and non-aviation sector). However, an EBIT based assessment of an airport's funding gap would go too far, including in the scope of operating aid also investments that are indeed already eligible for investment aid.

An alternative definition of an airport's funding gap could include in the scope for operating aid some of the capital costs for non-aviation assets that are completely excluded from investment

[110] This is the maximum permissible amount of aid for airports with average annual traffic below 1M passengers. For larger airports the ceiling is lower.

aid (this is equivalent to say that since non-aviation investments are not entitled to investment aid, only net profits from non-aviation activities are accounted for to cover operating costs).

There is no data in the sample at hand regarding the split of aviation and non-aviation investments or assets. However, the shares of aviation and non-aviation revenues can be used as a proxy for the shares of aviation and non-aviation assets. In order to make at least a rough assessment of the impact of a definition going in this direction, we have estimated how the baseline results from section 6.2.1 would change should the scope for operating aid be extended to allowing the deduction of all investment costs currently excluded from the perimeter of investment aid, that is, 25% of aviation investments' depreciation and 100% of non-aviation investments' depreciation:

$$AFG \quad = (EBITDA \ - net\ public\ resources) - \ d \cdot (0.25 \cdot s_1 + \cdot s_2)$$

where the first term in the right-hand side of the equation is OFG as currently defined in the Aviation Guidelines; d are total depreciation costs and s_1 and s_2 are, respectively, the shares of aviation and non-aviation revenues. This calculation captures financial viability including components of costs that may be crucial to achieve a sound performance in the long run and that are currently excluded from the area of State aid under the Aviation Guidelines. Based on this alternative definition of the funding gap, the Team has assessed whether each of the airports included in the sample would be expected to be in equilibrium in 2024, at the end of the transitional period.

Table B.3 shows the results of this analysis for the airports that provided information essential to the definition, i.e. data on depreciations and amortizations. The first two columns of Table B.3 report the number and percentage by class of airports that would record a positive AFG in 2024 (that is, when using the alternative definition of the funding gap sketched above. To ease the comparison with the baseline assessment performed in section 6.2.1, the last column of Table B.3 reports – for the same subsample of airports – the results when using the Aviation Guidelines' definition of OFG (as implemented in this Study). Clearly, the number of airports that are not in equilibrium in 2024 increases, as the AFG enlarges the scope for operating aid to costs components that are now excluded from it. In addition to the deterioration of the proportion of airports in class 1 and 2 that would have a non-negative funding gap in 2024, some airports in the third class (around 10%) would also need financial support. On the contrary, airports that belong to class 4 and 5 would still be fully viable in 2024.

Table B.3 Distribution by class of airports that will have a positive AFG in 2024

Class	All Airports for which AFG is defined (Total number)	Airports in equilibrium applying AFG definition (Total number)	Airports in equilibrium applying the AFG definition (% of class total)	Airports in equilibrium applying the OFG definition (% of class total)
1	8	1	12.50%	37.5%
2	24	13	54.17%	70.8%
3	9	8	88.89%	100.0%
4	16	16	100.00%	100.0%

5	7	7	100.00%	100.0%
Total	64	45	70.31%	81.3%

Source: Team based on sample data. AFG is an alternative definition of the funding gap of airports, which includes among eligible costs for operating aid also capital costs that are not eligible for investment aid. The comparison is made only for airports that provided the relevant information on capital costs.

We conclude, however, remarking that the assessment of the opportunity to extend the scope of operating aid to include some components of capital costs, would clearly suggest evaluating jointly the scope of both operating and investment aid in order to capture all the possible interactions between the two areas of State aid.

Additional Evidence on the evaluation of aid intensity (section 6.2.5)

Results in section 6.2.5 show that only some airports in class 2 (i.e. where traffic is between 200,001 and 700,000 passengers per year) are expected to report, during the transitional period, an OFG greater than the maximum amount of operating aid that they could virtually receive. The latter depends on their ex-ante needs (average initial OFG before the transitional period) and on the maximum aid intensity permitted under the Aviation Guidelines, as well as on their ex-post needs of funding (OFG expected during the transitional period).

Table B.4 Aid intensity adequacy: distribution of airports in class 2 over more detailed passenger levels ('000)

Passenger range within class 2	All airports with OFG defined	Number of airports with initial OFG < 0	Number of airports with initial OFG < 0 and OFG < 0	Number of airports where max aid < OFG
(200,300]	8	6	5	5
(300,400]	8	3	2	1
(400,500]	5	3	2	0
(500,600]	3	0	--	--
(600,700]	2	1	0	--
Total	26	13	9	6

Source: Team based on sample data. Note: Initial OFG is the (ex-ante) Operating Funding Gap computed over the period 2010-2014. Instead, OFG is the (ex-post) Operating Funding Gap of airports during the transitional period (2015-2024). Maximum aid entitlement is determined based on initial OFG.

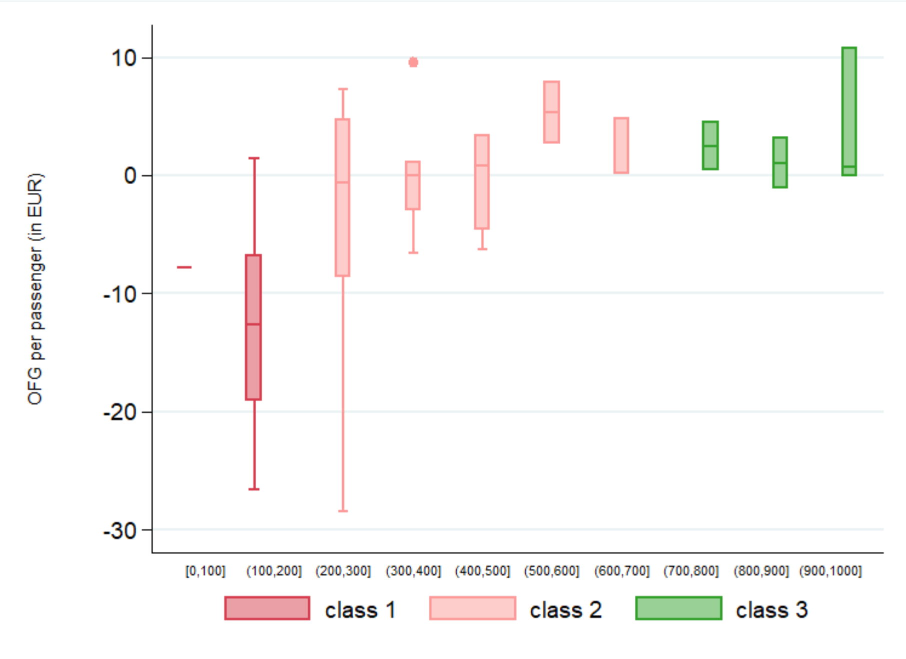
ANNEX C. ADDITIONAL ANALYSES TO SECTION 7

Evidence on OFG 2015-2018 (reference to section 7.2.1)

Figure C.1 Boxplot of OFG per passenger (in EUR based on average values over the years 2015-2018), by classes

Source: Team based on sample data. The boxplot presents the distribution of OFG per passenger (where OFG is the Operating Funding Gap at the airport level), based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each class of airports. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000).

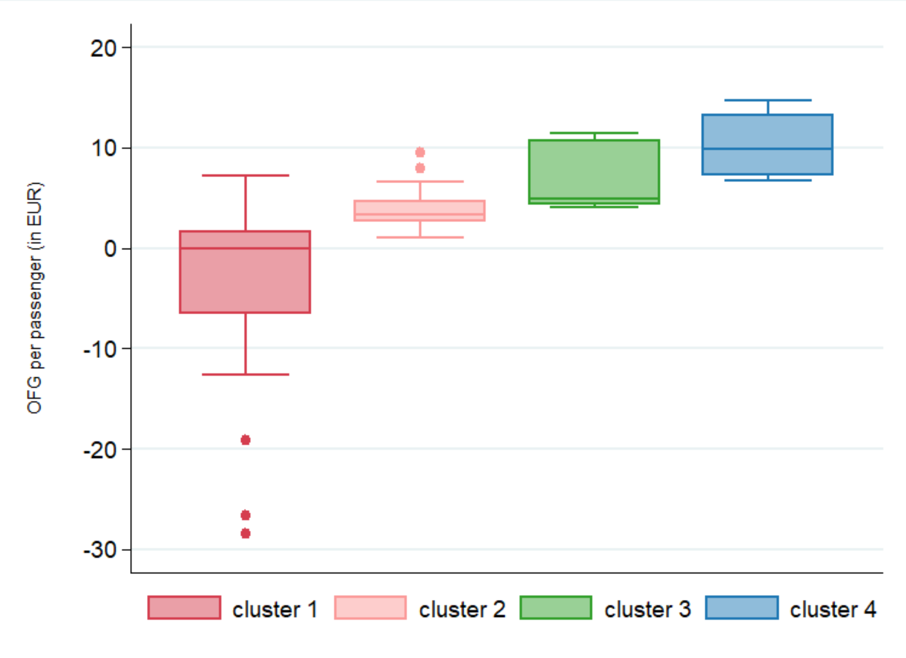
Figure C.2 Boxplot of OFG per passenger (in EUR based on average values over the years 2015-2018), by passenger levels



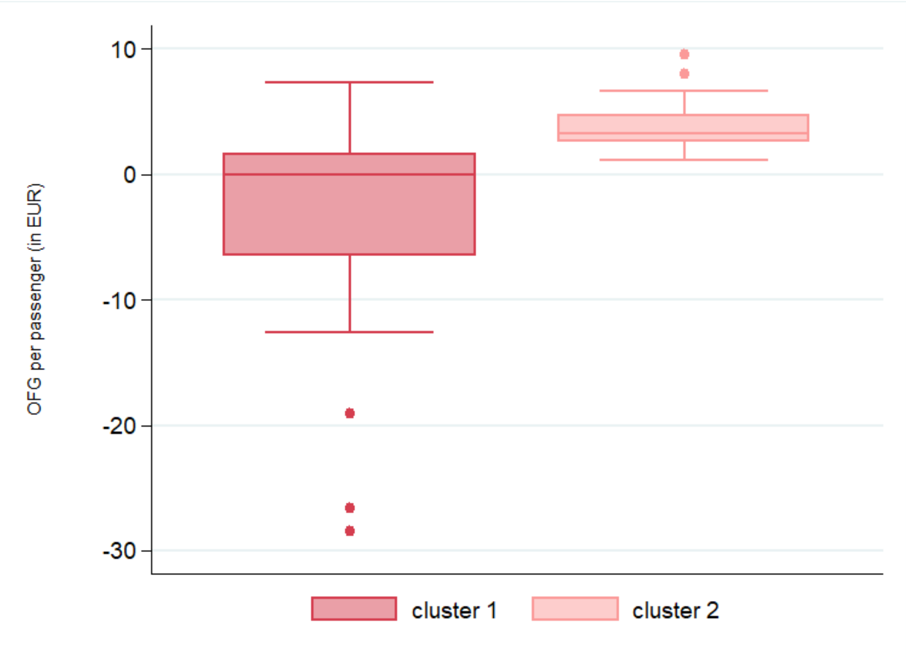
Source: Team based on sample data. Note: The boxplot presents the distribution of the OFG per passenger (where OFG is the Operating Funding Gap at the airport level), based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values by airports' passenger levels. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers over the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports with an average number of passengers in the years 2015-2018 not exceeding 1 million passengers.

Figure C.3 Boxplot of OFG per passenger (in EUR based on average values over the years 2015-2018), by clusters

Panel (a): all clusters



Panel (b): focus on the first two clusters



Source: Team based on sample data. The boxplot presents the distribution of OFG per passenger (where OFG is the Operating Funding Gap at the airport level), based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each cluster of airports. Airports are grouped into clusters based on 2015 to 2018 OFG. Clusters' IDs are increasing in average OFG.

Evidence on predicted OFG 2019-2024 (reference to section 7.2.1)

In section 7.2.1 we present a descriptive analysis based on average realized values of OFG over the period 2015-2018, to explore how OFG is distributed over different airport's passenger ranges, assigning an airport to the range it most frequently characterize the airport in the same period. Here we present the same analyses based on predicted OFG values over the period 2019-2024.

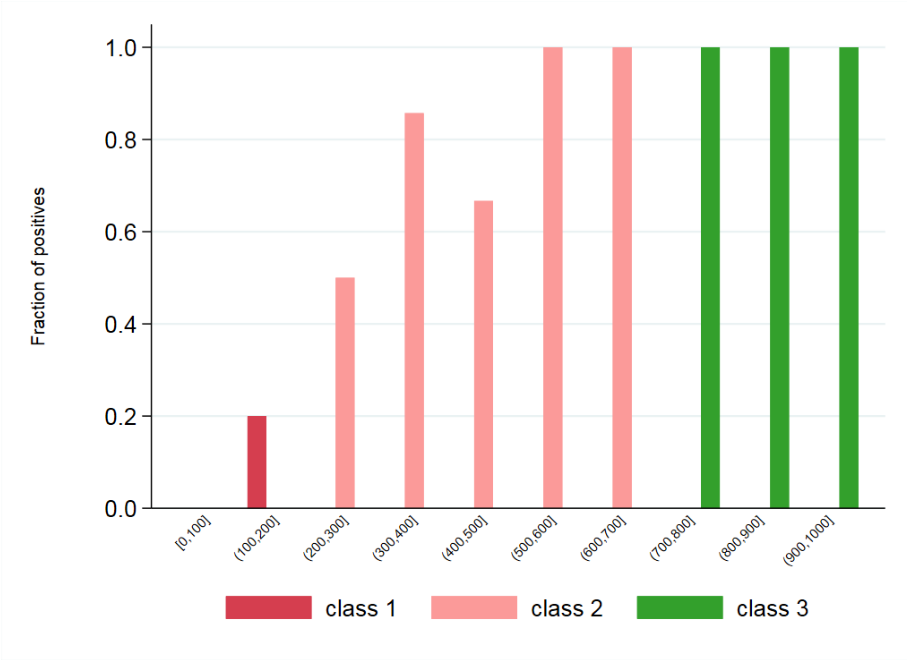
Figure C.4 Panel (a) uses the average numbers of passengers form the period 2015-2019 to show how OFG is distributed over different passenger ranges. The figure is almost identical to the one presented above. The main difference with respect to section 7.2.1 is that, now, airports with average traffic between 200,001 and 500,000 passengers appear more profitable, making class 2 more homogenous.

If we instead look at the average predicted number of passengers for the period 2019-2024 (Figure C.4 Panel b), the figure looks a bit different, as for all bins below 800,000 passengers, we observe a fraction of unprofitable airports. Nevertheless, also this analysis hints to the fact that class 2 appears to be quite homogenous and, in this sense, well defined.

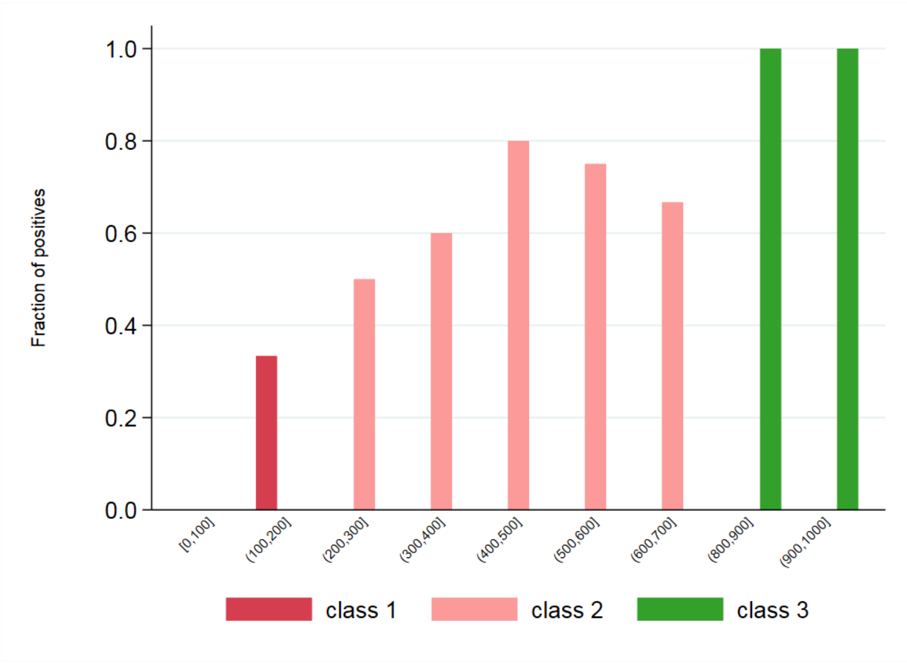
Moreover, airports in class 1 also appear to be quite different than others as the percentage of airports with a positive average OFG is still well below 50%.

Figure C.4 Fraction of airports with positive average predicted OFG in the years 2019-2024, by passenger levels

Panel (a): Passenger traffic based on average values in 2015-2018



Panel (b) Passenger traffic based on average predicted values for the years 2019-2024



Source: Team based on sample data. Note: OFG is the Operating Funding Gap at the airport level. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers over the relevant period (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports with an average number of passengers not exceeding 1 million passengers. There are no airports in the passenger range of (700,800] in Panel (b).

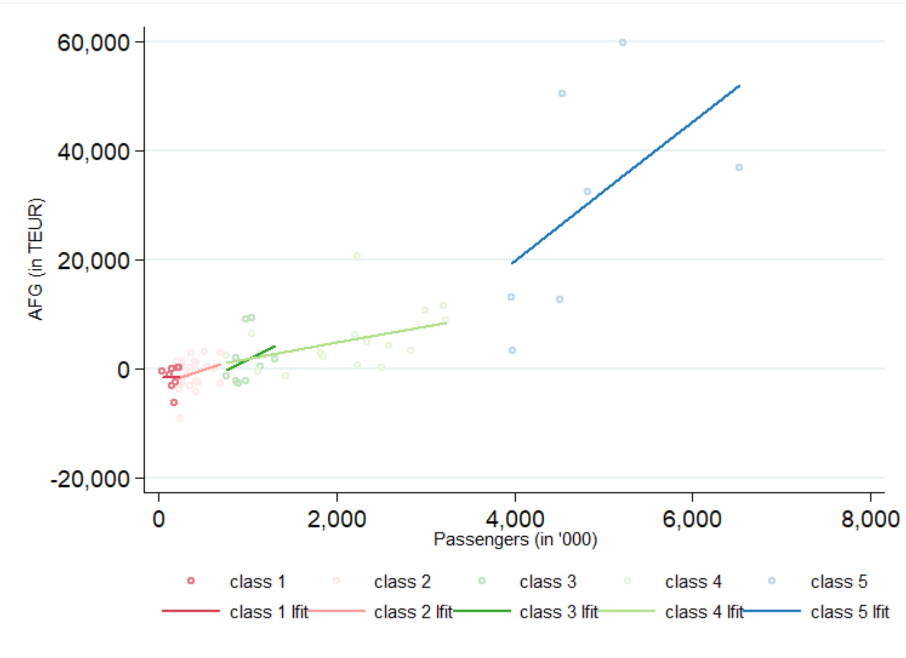
Evidence on AFG as profitability measure (reference to section 7.2.1-7.2.2)

An alternative measure of an airport's funding gap (AFG) has been discussed at length in Annex B, where we have already highlighted that any conclusion regarding the opportunity to extend the scope of operating aid to include some components of capital costs, should clearly be examined taking fully into account overlapping, possible interactions and necessary coordination among the two areas of State aid, operating and investment aid; as well as any effects on airports' incentives that such a policy may induce.

We also want to underscore that AFG is only a rough attempt to include in the funding needs of airports capital costs that are non-eligible for investment aid, given the absence of data in the survey on capital costs breakdowns (for reference see in Annex B).

In this section the analyses performed under section 7.2.1-7.2.2 are replicated using AFG as a measure of profitability of airports. Our results are quantitatively similar, with the difference that the entire distribution is shifted downwards.

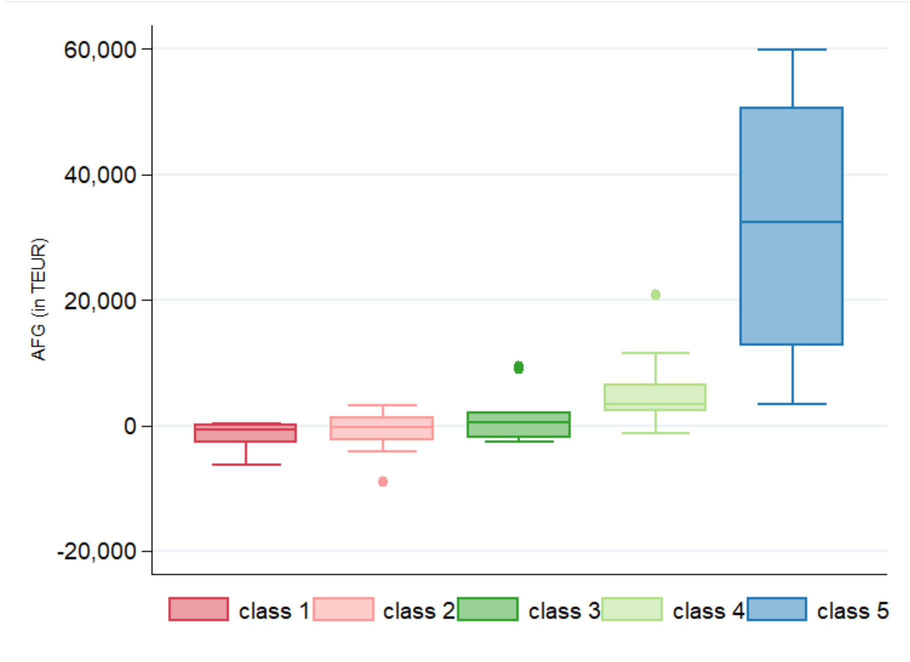
Figure C.5 Relationship between AFG (in TEUR) and Passengers (in thousands), average values over the years 2015-2018



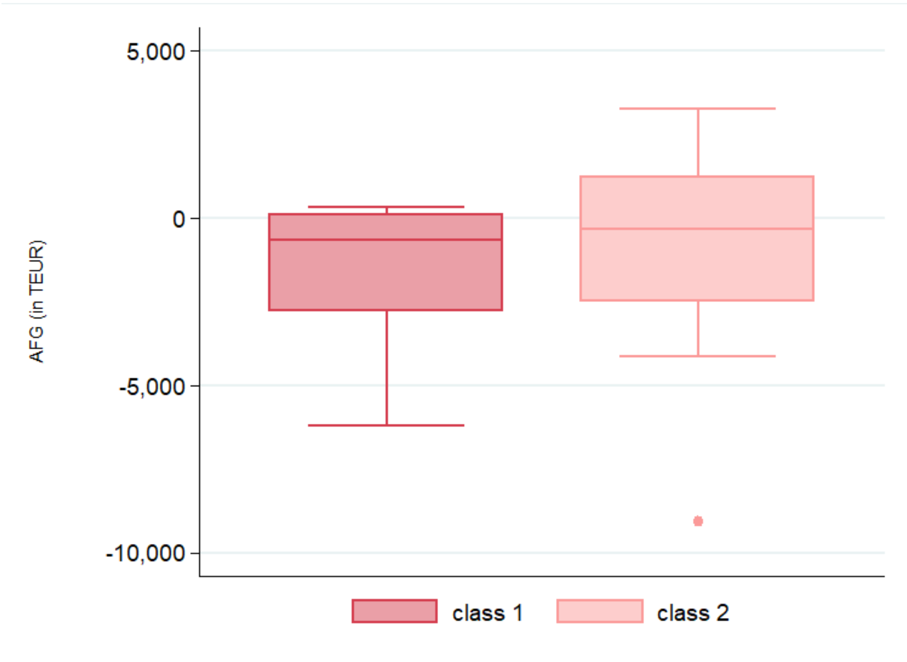
Source: Team based on sample data. Note: Airport-level data. AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "lfit" is a shortcut for "linear fit", a straight line representing the best linear prediction of the variable reported on the vertical axis (AFG) by the variable reported on the horizontal axis (passengers). "TEUR" is a shortcut for thousands of Euros.

Figure C.6 Boxplot of AFG (in TEUR based on average values over the years 2015-2018), by classes

Panel (a): all classes



Panel (b): focus on the first two classes



Source: Team based on sample data. Note: AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. The boxplot presents the distribution of AFG, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each class of airports. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "TEUR" is a shortcut for thousands of Euros.

Figure C.7 Boxplot of AFG per passenger (in EUR based on average values over the years 2015-2018), by classes

Source: Team based on sample data. Note: AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. The boxplot presents the distribution of AFG per passenger, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each class of airports. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000).

Table C.1 Fraction of airports with positive AFG (based on average values over the years 2015-2018), by class

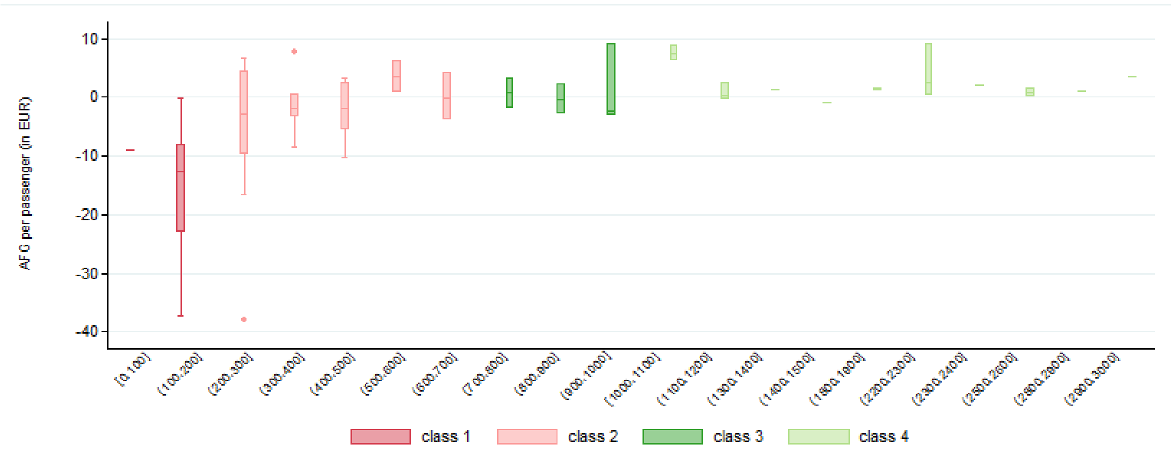
Class	AFG Positive N airports	AFG Positive %	AFG Negative N airports	AFG Negative %
class 1 (<200k)	2	25%	6	75%
class 2 (200-700k)	11	46%	13	54%
class 3 (700k-1M)	5	56%	4	44%
class 4 (1-3M)	15	88%	2	12%
class 5 (>3M)	7	100%	0	0%

Source: Team based on sample data.

Figure C.8 Boxplot of AFG (in TEUR based on average values over the years 2015-2018), by passenger levels

Source: Team based on sample data. Note: AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. The boxplot presents the distribution of AFG, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values by airports' passenger levels. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers over the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports not exceeding 3 million passengers. "TEUR" is a shortcut for thousands of Euros.

Figure C.9 Boxplot of AFG per passenger (in EUR based on average values over the years 2015-2018), by passenger levels



Source: Team based on sample data. Note: AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. The boxplot presents the distribution of AFG per passenger, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values by airports' passenger levels. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers over the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports not exceeding 3 million passengers.

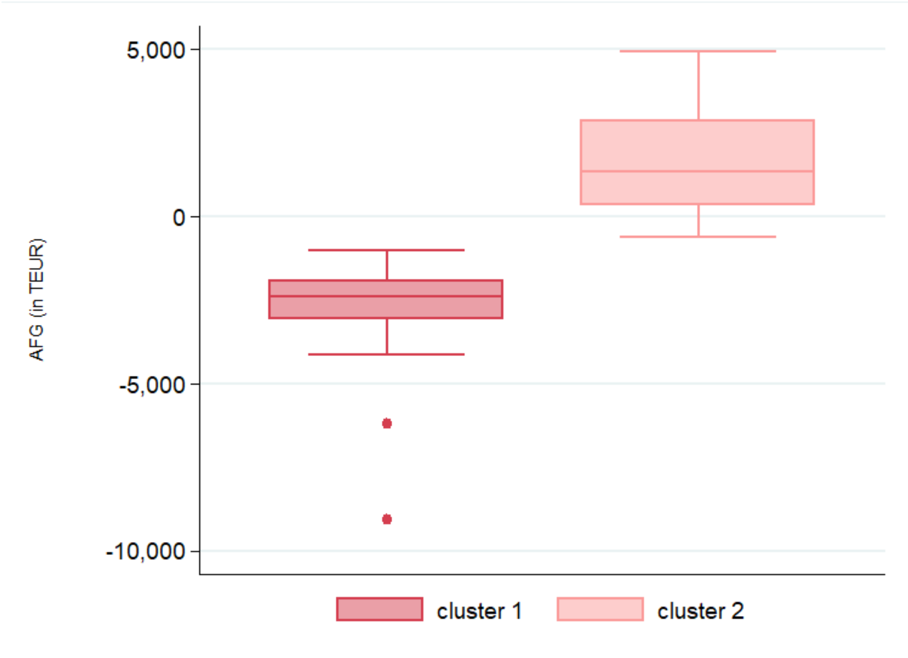
Figure C.10 Fraction of airports with positive AFG (based on average values over the years 2015-2018), by passenger levels

Source: Team based on sample data. Note: AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers over the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports with an average number of passengers in the years 2015-2018 not exceeding 3 million passengers.

Figure C.11 Boxplot of AFG (in TEUR based on average values over the years 2015-2018), by clusters

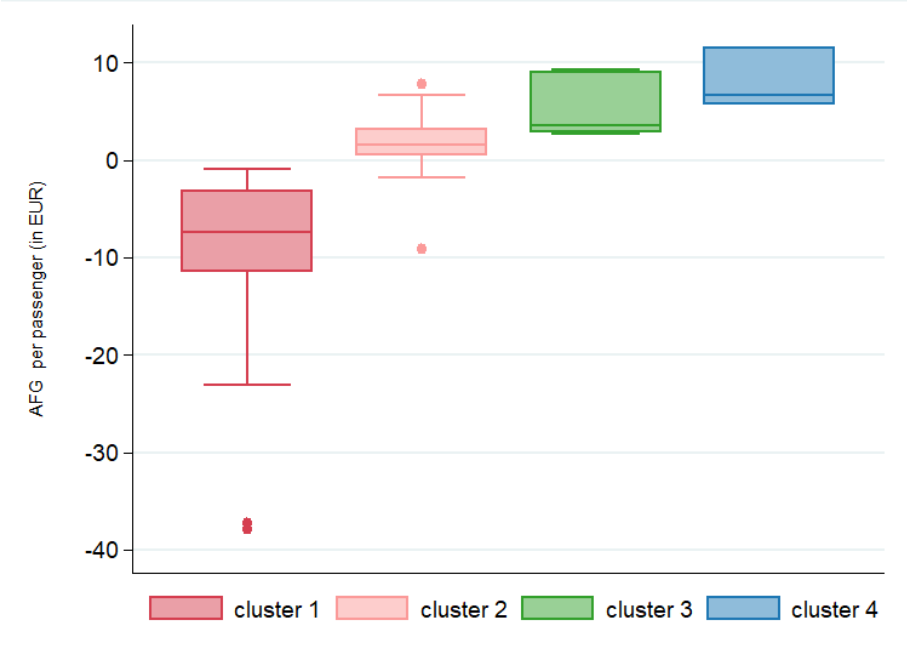
Panel (a): all clusters

Panel (b): focus on the first two clusters



Source: Team based on sample data. Note: AFG is an alternative definition of *an Airport's Funding Gap including capital costs non-eligible for investment aid. The boxplot presents the distribution of* AFG, *based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each cluster of airports. Airports are grouped into clusters based on 2015 to 2018 AFG. Clusters' IDs are increasing in average AFG. "TEUR" is a shortcut for thousands of Euros.*

Figure C.12 Boxplot of AFG per passenger (in EUR based on average values over the years 2015-2018), by clusters



Source: Team based on sample data. Note: AFG is an alternative definition of *an Airport's Funding Gap including capital costs non-eligible for investment aid. The boxplot presents the distribution of AFG per passenger, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each cluster of airports. Airports are grouped into clusters based on 2015 to 2018 AFG. Clusters' IDs are increasing in average AFG.*

Table C.2 Summary statistics: AFG (in TEUR based on average values over the years 2015-2018), by clusters

Clusters	Mean TEUR	SD TEUR	Min TEUR	Max TEUR	N airports
Cluster 1	-2,849	1,884	-9,052	-1,000	20
Cluster 2	1,575	1,486	-611	4,937	30
Cluster 3	10,863	4,189	6,144	20,748	10
Cluster 4	43,078	14,732	32,469	59,898	3

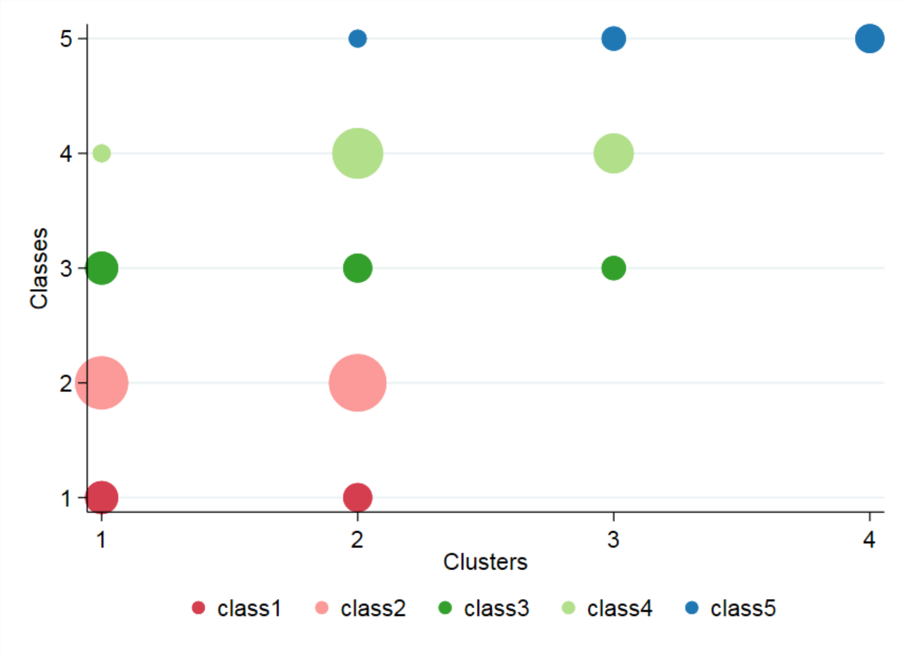
Source: Team based on sample data. Clustering based on 2015 to 2018 AFG. Clusters' IDs are increasing in average AFG.

Table C.3 Number and percentage of airports (2010-2018), by cluster and class

Class	Cluster 1	Cluster 2	Cluster 3	Cluster 4	**Total, by class**
class 1	4	3	0	0	7
(<200k)	57%	43%	0%	0%	100%
class 2	11	13			24
(200-700k)	46%	54%	0%	0%	100%
class 3	4	3	2		9
(700k-1M)	44%	33%	22%	0%	100%
class 4	1	10	6		17
(1-3M)	6%	59%	35%	0%	100%
class 5	0	1	2	3	6
(>3M)	0%	17%	33%	50%	100%
Total, by cluster	20	30	10	3	63
	32%	48%	16%	5%	100%

Source: Team based on sample data. Clustering based on 2015 to 2018 AFG. Clusters' IDs are increasing in average AFG.

Figure C.13 Number of airports (2015-2018), by cluster and class



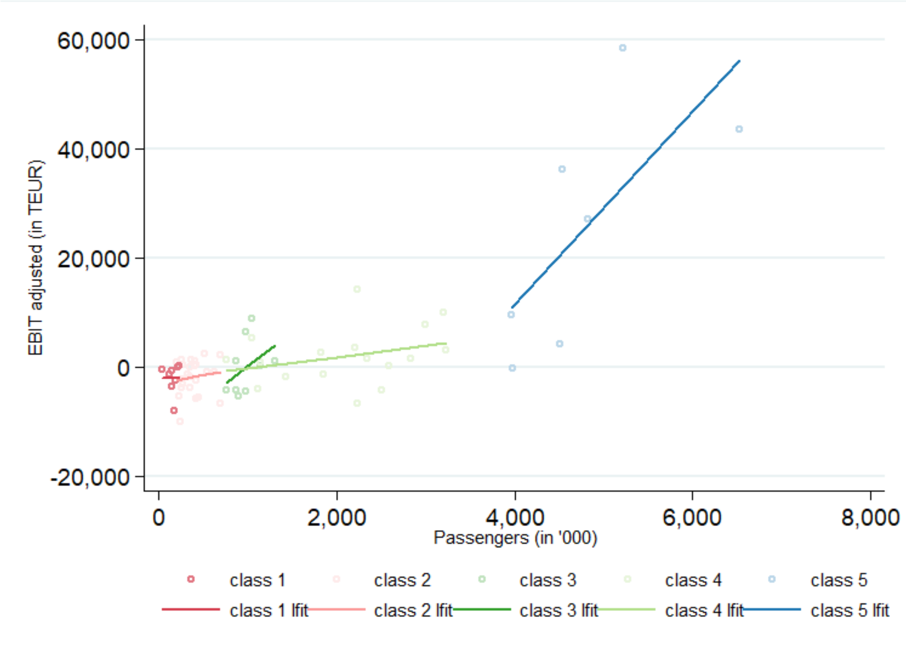
Source: Team based on sample data. Note: On the one side (vertical axis), airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). On the other side (horizontal axis), airports are grouped into clusters based on 2015 to 2018 AFG, where AFG is an alternative definition of an Airport's Funding Gap including capital costs non-eligible for investment aid. Clusters' IDs are increasing in average AFG.

Evidence using EBIT adjusted as profitability measure (reference to section 7.2.1-7.2.2)

The analysis presented in sections 7.2.1-7.2.2 has been replicated using a different measure of profitability: EBIT adjusted, which is calculated as *Earnings before interests and taxes* minus operating aid received by an airport.

As already explained in section 7.2.2, this definition of profitability raises is not appropriate as a metric to evaluate the adequacy of airports' categorisation for operating aid rules. EBIT adjusted equals EBITDA minus public operating aid minus all capital costs accrued in a given year (i.e. total depreciations and amortization), including the ones that are already eligible for investment aid. Thus, EBIT adjusted does not allow to control for capital costs for which an airport may be entitled to receive (or may indeed have received) a different type of public support. In this sense, AFG (introduced in Annex B and analysed in Annex C) appears to be a better measure because, as explained in detail in Annex B, it aims at including among funding needs only capital costs that are not eligible for investment aid (even though the implementation in this Study has been constrained by the lack of data on capital costs breakdowns). In any circumstance, both EBIT adjusted and AFG cannot be considered in isolation to evaluate the scope for operating aid; they could rather inform a joint assessment of both operating aid and investment aid rules.

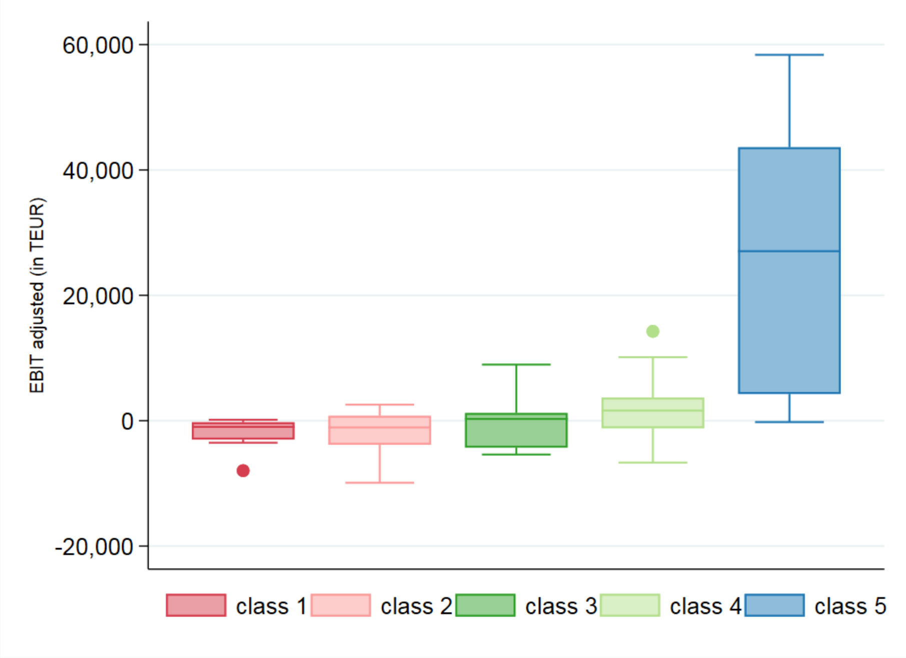
Figure C.14 Relationship between EBIT adjusted (in TEUR) and Passengers (in thousands), average values over the years 2015-2018



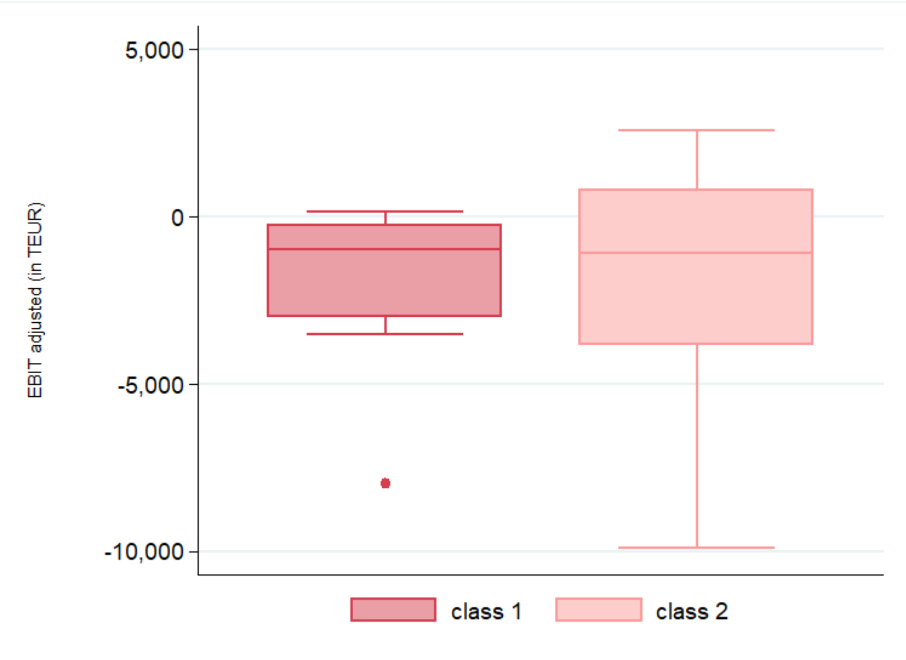
Source: Team based on sample data. Note: Airport-level data. EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "lfit" is a shortcut for "linear fit", a straight line representing the best linear prediction of the variable reported on the vertical axis (EBIT-adjusted) by the variable reported on the horizontal axis (passengers). "TEUR" is a shortcut for thousands of Euros.

Figure C.15 Boxplot of EBIT adjusted (in TEUR based on average values over the years 2015-2018), by classes

Panel (a): all classes

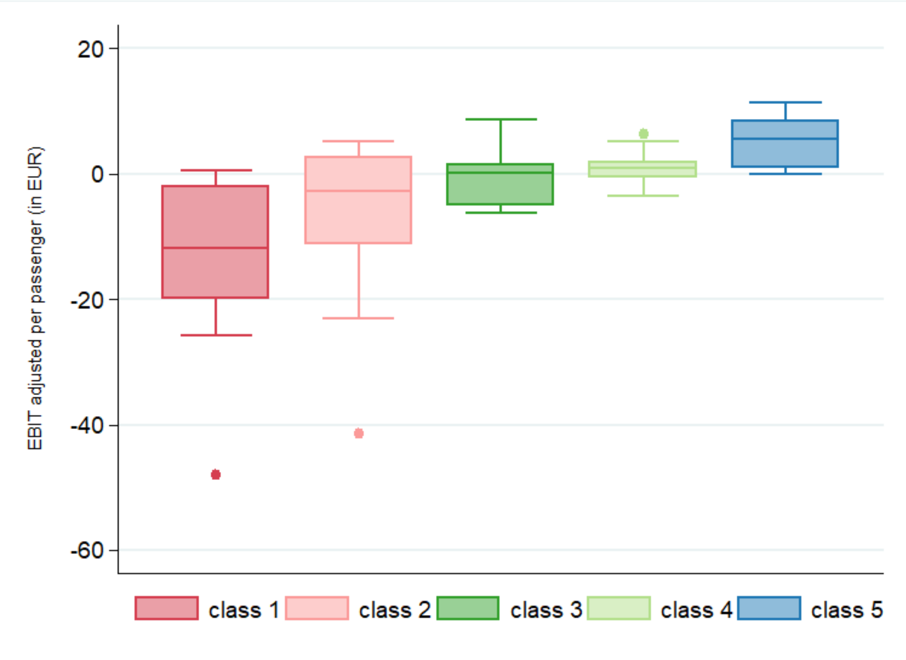


Panel (b): focus on the first two classes



Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. The boxplot presents the distribution of EBIT adjusted, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each class of airports. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "TEUR" is a shortcut for thousands of Euros.

Figure C.16 Boxplot of EBIT adjusted per passenger (in EUR based on average values over the years 2015-2018), by classes



Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. The boxplot presents the distribution of EBIT adjusted per passenger, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each class of airports. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000).

Table C.4 Fraction of airports with positive EBIT adjusted (based on average values of EBIT adjusted over the years 2015-2018), by class

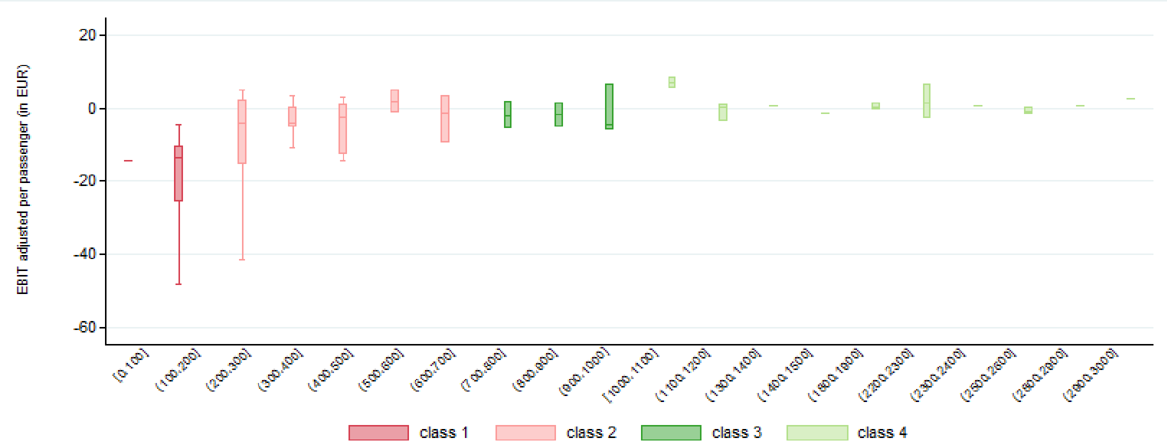
Class	EBIT adjusted Positive N airports	EBIT adjusted Positive %	EBIT adjusted Negative N airports	EBIT adjusted Negative %
class 1 (<200k)	2	25%	6	75%
class 2 (200-700k)	10	42%	14	58%
class 3 (700k-1M)	5	56%	4	44%
class 4 (1-3M)	12	71%	5	29%
class 5 (>3M)	6	86%	1	14%

Source: Team based on sample data.

Figure C.17 Boxplot of EBIT adjusted (in TEUR based on average values over the years 2015-2018), by passenger levels

Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. The boxplot presents the distribution of EBIT adjusted, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values by airports' passenger levels. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers in the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports not exceeding 3 million passengers. "TEUR" is a shortcut for thousands of Euros.

Figure C.18 Boxplot of EBIT adjusted per passenger (in EUR based on average values over the years 2015-2018), by passenger levels



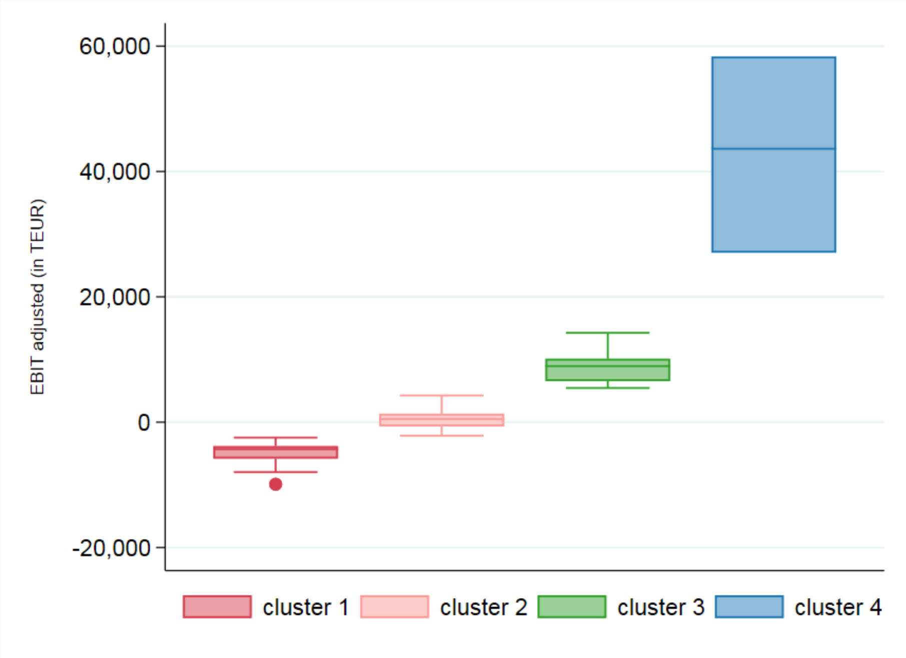
Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. The boxplot presents the distribution of EBIT adjusted per passenger, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values by airports' passenger levels. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers in the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports not exceeding 3 million passengers.

Figure C.19 Fraction of airports with positive EBIT adjusted (based on average values over the years 2015-2018), by passenger levels

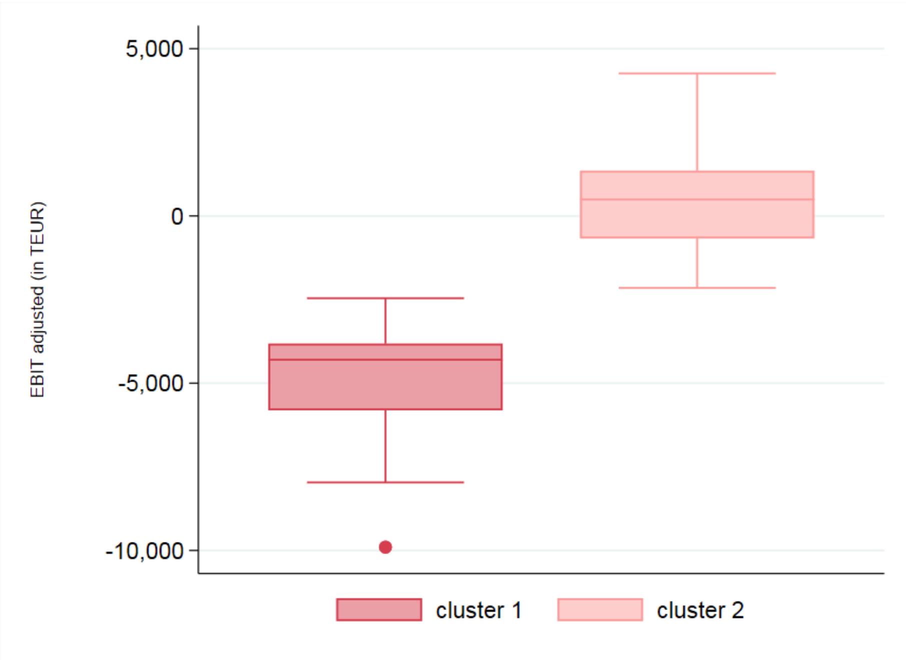
Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. Airports are grouped into 5 classes and by passenger levels based on the average number of passengers in the years 2015-2018 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). The figure is restricted to airports not exceeding 3 million passengers.

Figure C.20 Boxplot of EBIT adjusted (in TEUR based on average values over the years 2015-2018), by clusters

Panel (a): all clusters

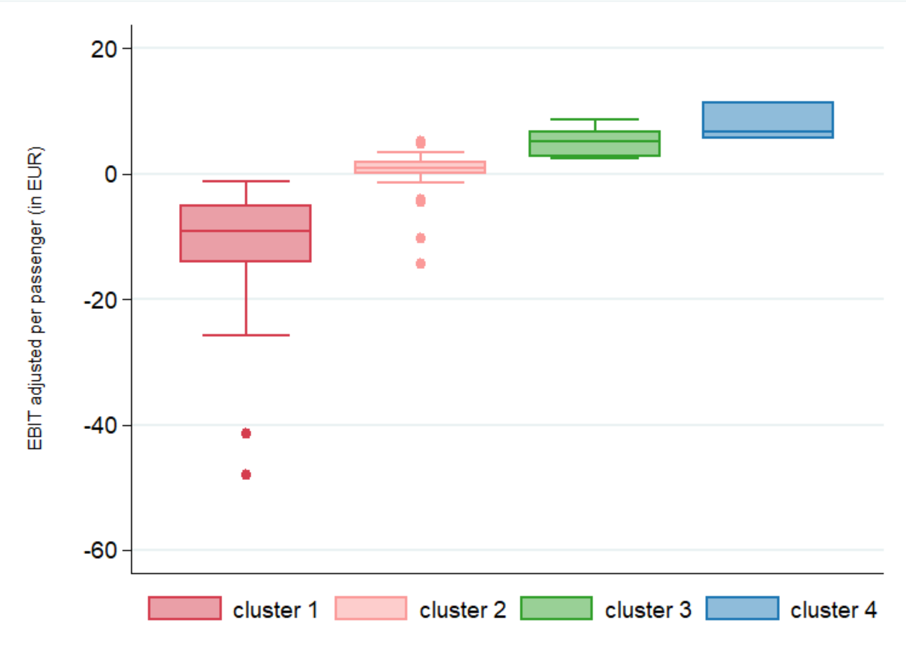


Panel (b): focus on the first two clusters



Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. The boxplot presents the distribution of EBIT adjusted, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each cluster of airports. Airports are grouped into clusters based on 2015 to 2018 EBIT adjusted. Clusters' IDs are increasing in average EBIT adjusted.

Figure C.21 Boxplot of EBIT adjusted per passenger (in EUR based on average values over the years 2015-2018), by clusters



Source: Team based on sample data. Note: EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. The boxplot presents the distribution of EBIT adjusted per passenger, based on a five-number summary, respectively the minimum, the first quartile, the median, the third quartile, and the maximum values for each cluster of airports. Airports are grouped into clusters based on 2015 to 2018 EBIT adjusted. Clusters' IDs are increasing in average EBIT adjusted.

Table C.5 Summary statistics: EBIT adjusted (in TEUR based on average values over the years 2015-2018), by clusters

Clusters	Mean TEUR	SD TEUR	Min TEUR	Max TEUR	N airports
Cluster 1	-4,929	1,883	-9,902	-2,460	19
Cluster 2	607	1,590	-2,151	4,262	34
Cluster 3	8,949	2,864	5,454	14,256	7
Cluster 4	43,011	15,671	27,043	58,366	3

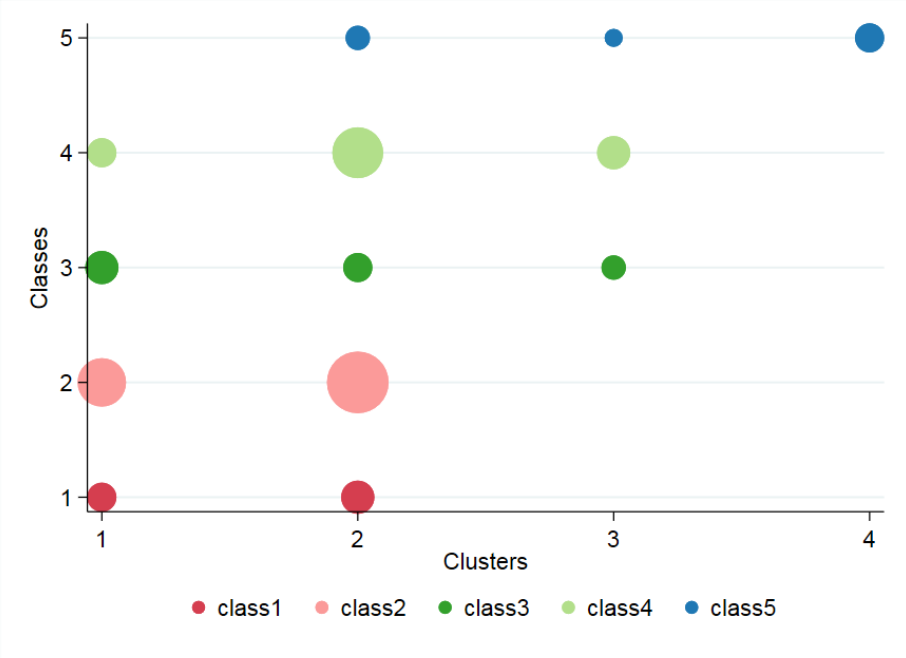
Source: Team based on sample data. Clustering based on 2015 to 2018 EBIT adjusted. Clusters' IDs are increasing in average EBIT adjusted.

Table C.6 Number and percentage of airports (2010-2018), by cluster and class

Class	Cluster 1	Cluster 2	Cluster 3	Cluster 4	**Total, by class**
class 1	3	4			7
(<200k)	43%	57%	0%	0%	100%
class 2	9	15			24
(200-700k)	38%	63%	0%	0%	100%
class 3	4	3	2		9
(700k-1M)	44%	33%	22%	0%	100%
class 4	3	10	4		17
(1-3M)	18%	59%	24%	0%	100%
class 5		2	1	3	6
(>3M)	0%	33%	17%	50%	100%
Total, by cluster	19	34	7	3	63
	30%	54%	11%	5%	100%

Source: Team based on sample data. Clustering based on 2015 to 2018 EBIT adjusted. Clusters' IDs are increasing in average EBIT adjusted.

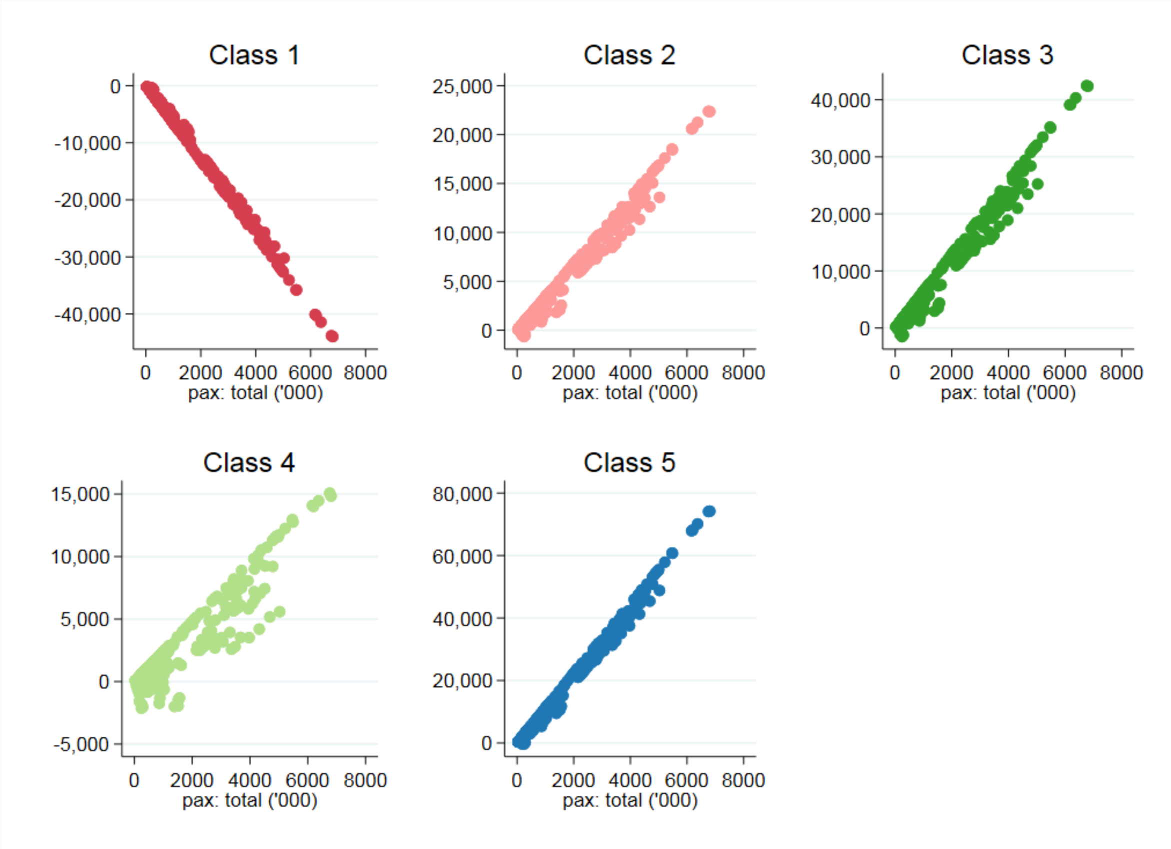
Figure C.22 Number of airports (2015-2018), by cluster and class



Source: Team based on sample data. Note: On the one side (vertical axis), airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). On the other side (horizontal axis), airports are grouped into clusters based on 2015 to 2018 EBIT adjusted, where EBIT-adjusted is Earnings before interests and taxes minus operating aid received by an airport. Clusters' IDs are increasing in average EBIT adjusted.

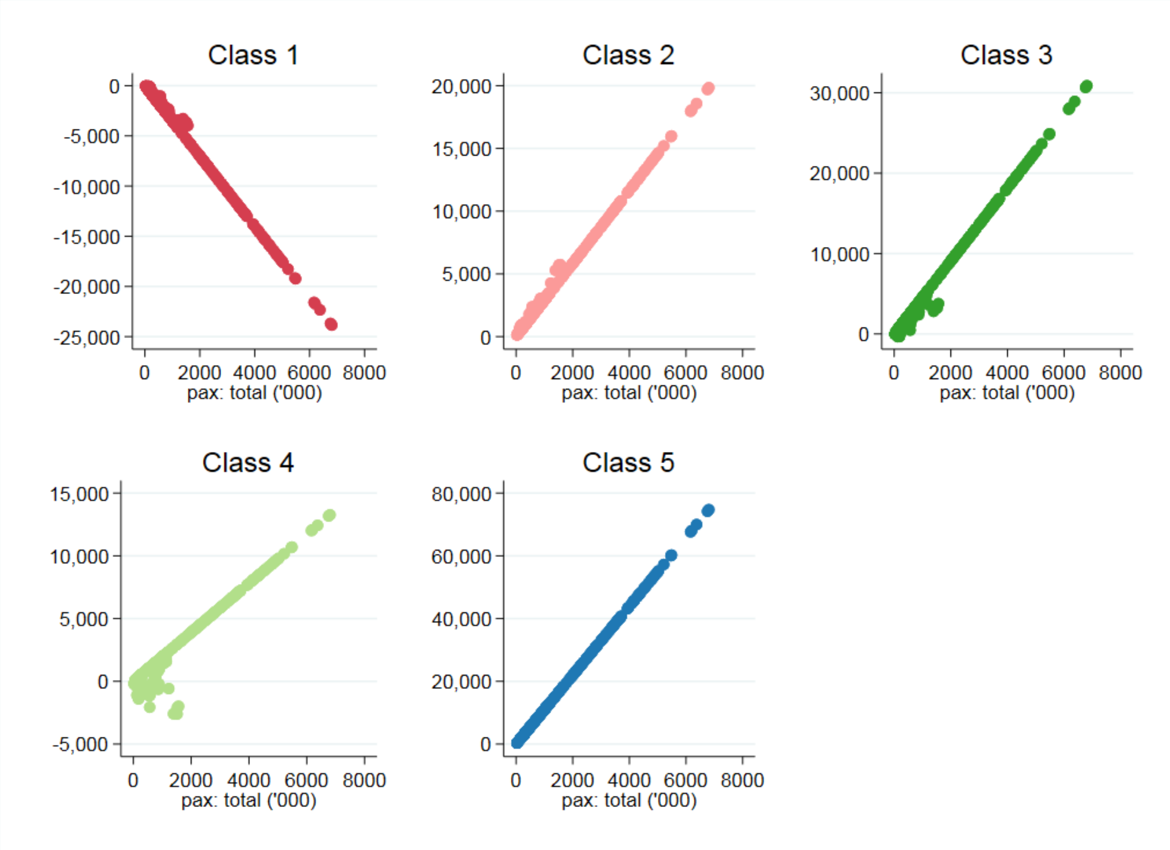
Additional Evidence from regression analysis (section 7.2.3)

Figure C.23 Net predicted impact of passengers on OFG (2015-2018), by class: model with interactions of passengers with incentives per passenger



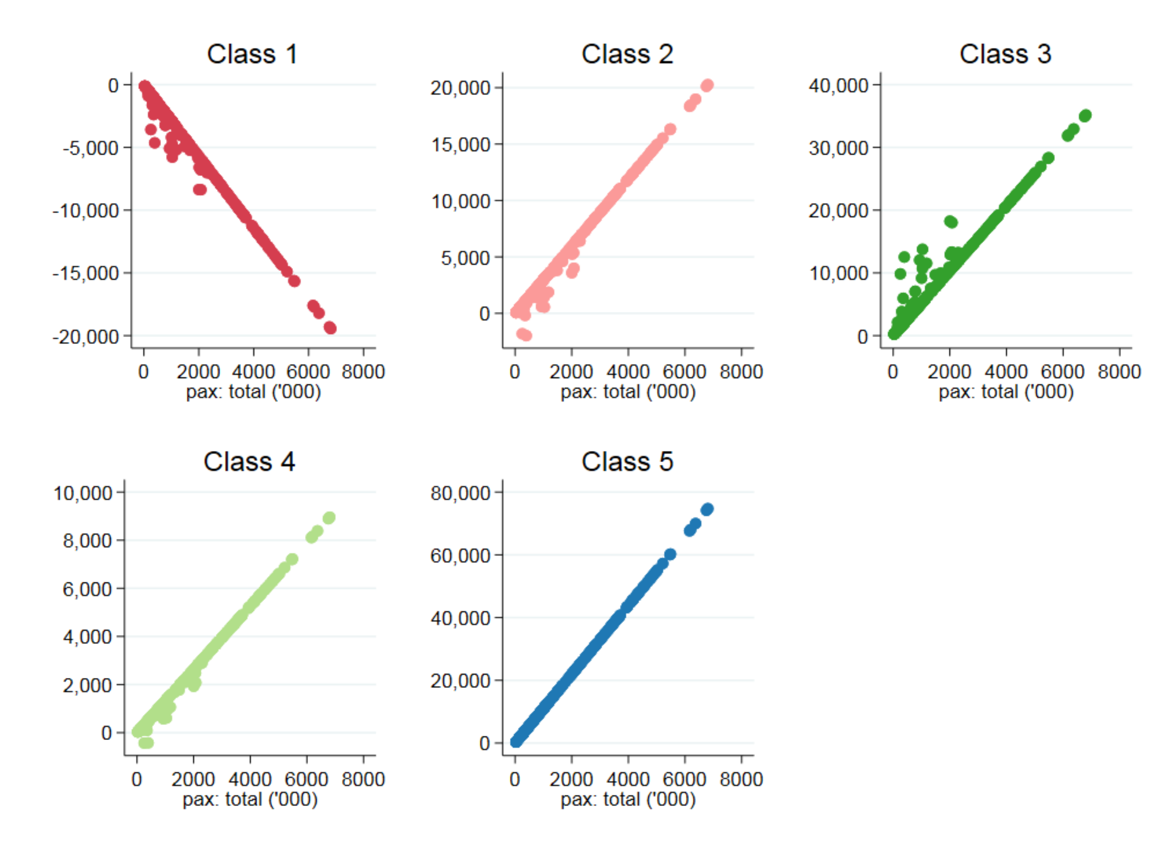
Source: Team based on sample data.

Figure C.24 Net predicted impact of passengers on OFG (2015-2018), by class: model with interactions of passengers with operating aid per passenger



Source: Team based on sample data.

Figure C.25 Net predicted impact of passengers on OFG (2015-2018), by class: model with interactions of passengers with investment aid per passenger



Source: Team based on sample data.

ANNEX D. TABLES

Airports contacted for the survey

A total of 147 airports were contacted for the survey: 94 of them were contacted as a result of the initial project planning, while the remaining 53 represented a second wave of airports launched to reach a reasonable minimum sample size.

During the first stages of the Study, a preliminary draft questionnaire was sent to four airports, located in four different countries, each of them belonging to either class 1, class 2, class 3 or class 4. The circulation of this preliminary survey ("Pilot") highlighted the risks of unavailability of airports to cooperate as well as significant delays in getting any type of response (submission or refusal to participate).

This led the Team to seek early support by the ACI and by several national airport associations, including the German Flughafenverband ADV, UAF, the French airports' union as well as the Italian Assaeroporti. These collaborations proved fruitful to identify more appropriate contact persons, where this had not been possible on the basis of desk research, and to have a positive dialogue with airports. In some cases, airports which had been initially unresponsive confirmed their participation thanks to national associations' support.

Notwithstanding the engagement of ACI and of national airport associations, the Team still encountered many difficulties and delays in collecting enough responses with sufficient and coherent data in time for the Study. First, airports were very slow even in acknowledging receipt of the questionnaires and in communicating whether they intended to participate or not. Second, many of them, especially smallest airports, voiced a number of concerns related to the limited resources that had at their disposal for the allocation of the survey workload. The Team was very permissive in accommodating all requests for extensions. Late in the process, concerns were also raised by some airports with regard to the confidentiality of the information they would have shared responding to the questionnaire, notwithstanding the confidentiality option they could specifically flag in the questionnaire. This led the Team to sign separate non-disclosure agreements ("NDAs") with some airports, in order to further reassure them about the complete anonymity and confidentiality of their responses. Moreover, the fact that some airports are operated as a network by one company proved to be problematic for two Member States in which all the selected airports were part of the same networks, which were unwilling to provide even estimates of financial data at the airport level, resulting in incomplete questionnaires for all the selected airports in those Member States.[111] This led the Team to launch a second wave of the survey, in order to ensure the best quality assessment.

Details on the total number of airports contacted for the survey and on the number of responses received are provided in the following tables.

[111] In a later stage of the project, one of the two networks decided to provide at least the essential financial data, even though for a shorter period.

Table D.1 Airports contacted for the survey

Country	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k-1m]	Class 4 (1m- 3m]	Class 5 > 3m	Total	Total (%)
AT		2	1	2		5	3,4%
CZ	1	2				3	2,0%
DE	5	3	3	6	1	18	12,2%
DK	2	2		2		6	4,1%
ES	1	2	3	3	1	10	6,8%
FI	1	3	1			5	3,4%
FR	9	14	1	6	2	32	21,8%
HR	1	1		2		4	2,7%
IT	3	6	1	8	3	21	14,3%
PL		4		2	2	8	5,4%
PT	2			2		4	2,7%
RO	2	3	1	1		7	4,8%
SE	4	4		2		10	6,8%
UK	3	5	1	3	2	14	9,5%
Total	34	51	12	39	11	147	100%
Total (%)	23,1%	34,7%	8,2%	26,5%	7,5%	100%	

Source: Team based on sample data.

Table D.2 Responses received to the survey

Country	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k-1m]	Class 4 (1m- 3m]	Class 5 > 3m	Total	Total (%)
AT			1			1	1,1%
CZ	1					1	1,1%
DE	3	3	1	2	1	10	11,5%
DK	1	1		2		4	4,6%
ES	1	2	3	3	1	10	11,5%
FI		3	1			4	4,6%
FR	3	8	1	3	1	16	18,4%
HR		1				1	1,1%
IT	2	4	1	4	3	14	16,1%
PL		3		1		4	4,6%
PT	2			1		3	3,4%
RO		2	1	1		4	4,6%
SE	3	3		2		8	9,2%
UK					1	1	1,1%
Total		3	1		2	6	6,9%
Total (%)	16	33	10	19	9	87	100,0%
	18,4%	37,9%	11,5%	21,8%	10,3%	1	

Source: Team based on sample data.

Summary statistics (2010-2018)

Table D.3 Summary statistics (2010-2018): Time varying variables

Variables	Units	Class 1 < 200k		Class 2 [200k-700k]		Class 3 (700k- 1M]		Class 4 (1M- 3M]		Class 5 > 3M	
		Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
EBITDA	[TEUR]	-1,119.92	1,680.42	355.14	2,165.27	3,866.90	4,238.70	6,485.87	7,129.86	31,869.57	20,513.95
OFG	[TEUR]	-1,288.40	1,611.21	-209.51	2,148.77	3,411.36	4,571.18	5,987.71	7,758.11	31,486.30	21,011.79
EBIT adjusted	[TEUR]	-2,011.47	2,238.36	-1,797.8	3,066.55	736.78	4,521.55	602.28	7,827.69	11,644.42	44,773.82
EBITDA per pax	[EUR]	-6.33	10.29	0.33	7.67	3.96	4.32	3.39	3.28	7.32	4.77
OFG per pax	[EUR]	-8.77	9.34	-1.47	7.57	3.41	4.71	3.02	3.68	7.21	4.90
EBIT adjusted per pax	[EUR]	-13.73	13.09	-5.89	10.72	0.44	4.87	0.20	4.02	2.62	9.83
Pax total	[‘000]	157.74	67.76	373.30	135.37	936.60	188.97	1,941.76	758.24	4,332.29	935.59
LCC pax	[‘000]	93.44	86.09	146.59	158.50	364.83	339.67	846.86	796.97	1,564.83	1,004.09
HC pax	[‘000]	30.14	56.17	74.13	87.96	112.01	104.58	166.70	268.53	273.59	299.98
FNC pax	[‘000]	33.13	46.89	156.41	142.28	452.56	244.78	928.80	807.96	2,474.43	1,004.98
Pax LCC/ Pax total		0.51	0.44	0.37	0.36	0.37	0.31	0.44	0.33	0.36	0.22
Pax HC/ Pax total		0.17	0.31	0.22	0.28	0.12	0.12	0.07	0.10	0.06	0.06
Pax FNC/ Pax total		0.31	0.40	0.41	0.36	0.49	0.26	0.49	0.33	0.58	0.22
Operating aid	[TEUR]	504.68	1011.90	396.00	1001.64	445.14	914.46	356.30	1695.93	0.00	0.00
Investment aid	[TEUR]	57.39	146.70	617.50	2257.43	292.13	1204.43	1209.47	3431.58	1265.23	1806.98
Operating aid per pax	[EUR]	4.44	6.77	1.30	3.51	0.54	1.12	0.25	1.16	0.00	0.00
Investment aid per pax	[EUR]	0.94	1.94	1.85	7.13	0.37	1.55	0.87	2.82	0.34	0.49
Incentives to airline per pax	[EUR]	5.76	5.92	1.72	2.82	2.34	2.18	1.05	1.39	0.77	0.75

Table D.3 Summary statistics (2010-2018): Time varying variables

Variables	Units	Class 1 < 200k		Class 2 [200k-700k]		Class 3 (700k- 1M]		Class 4 (1M- 3M]		Class 5 > 3M	
		Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Total revenues	[TEUR]	3323.10	1763.06	8343.73	3973.93	15249.27	7491.44	33151.36	20745.99	65693.19	22070.49
Revenues to pax	[EUR]	22.44	8.29	23.35	10.65	16.66	8.04	17.44	7.84	15.25	4.63
Non-aviation revenues	[TEUR]	642.56	469.98	2009.74	1321.07	5150.50	2865.77	12608.94	14925.73	22796.95	9772.86
Aviation revenues	[TEUR]	1750.02	1143.22	4335.07	2628.70	9643.23	6914.87	17201.24	8097.42	38471.55	18519.83
Non-aviation revenue share	[TEUR]	0.20	0.13	0.25	0.13	0.36	0.19	0.33	0.20	0.35	0.10
Private ownership	[0/1]	0.34	0.48	0.31	0.46	0.27	0.45	0.16	0.37	0.46	0.50
Airport belongs to a network	[0/1]	0.23	0.43	0.46	0.50	0.26	0.44	0.42	0.50	0.65	0.48

Table D.4 Summary statistics (2010-2018): Time invariant variables

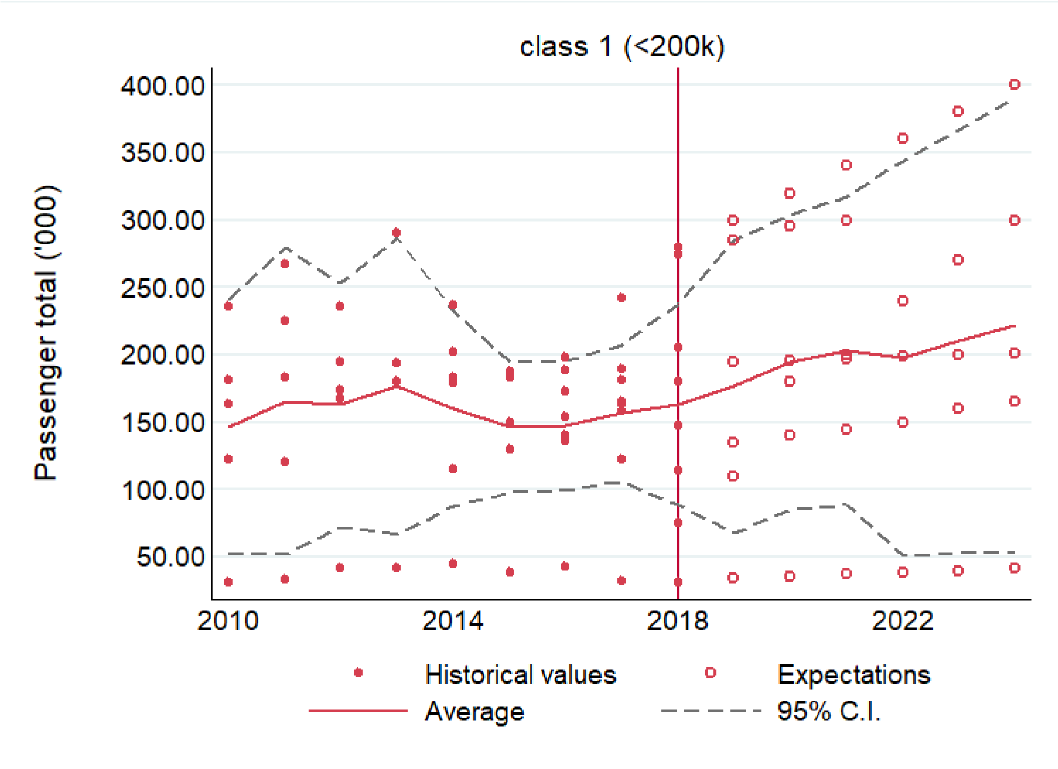
Variables	Units	Class 1 < 200k		Class 2 [200k-700k]		Class 3 (700k- 1M]		Class 4 (1M- 3M]		Class 5 > 3M	
		Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Revenue share of top carrier		0.60	0.19	0.54	0.24	0.45	0.11	0.47	0.24	0.31	0.10
Number of airports in official catchment area		1.56	1.24	0.63	1.28	0.67	0.71	1.24	1.35	1.29	1.80
Number of airports in self-reported catchment area		1.44	1.33	1.48	1.67	0.89	1.05	1.88	1.93	1.14	1.68
Number of self-reported competitors		2.63	2.00	2.56	1.83	3.00	1.79	3.77	1.88	3.33	1.63
Improving measures 2014-2018	[0/1]	0.44	0.53	0.56	0.51	0.44	0.53	0.63	0.50	0.43	0.53
Shock suffered 2014-2018	[0/1]	0.63	0.52	0.68	0.48	0.67	0.52	0.53	0.52	0.50	0.55

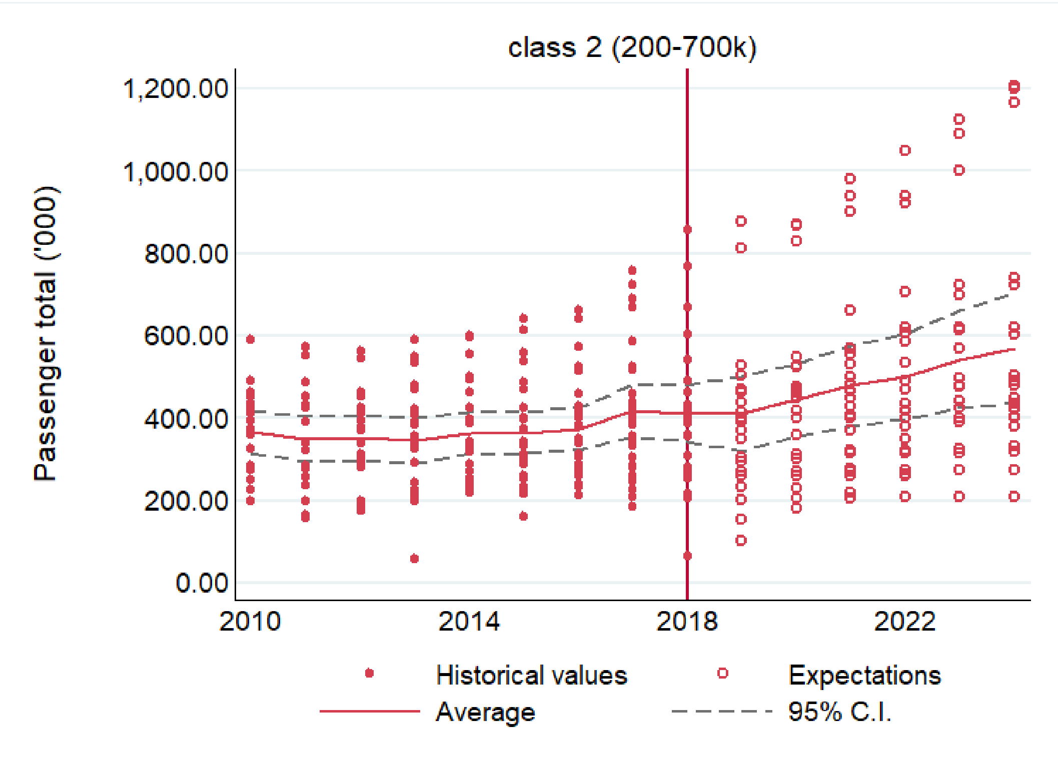
Source: Team based on sample data

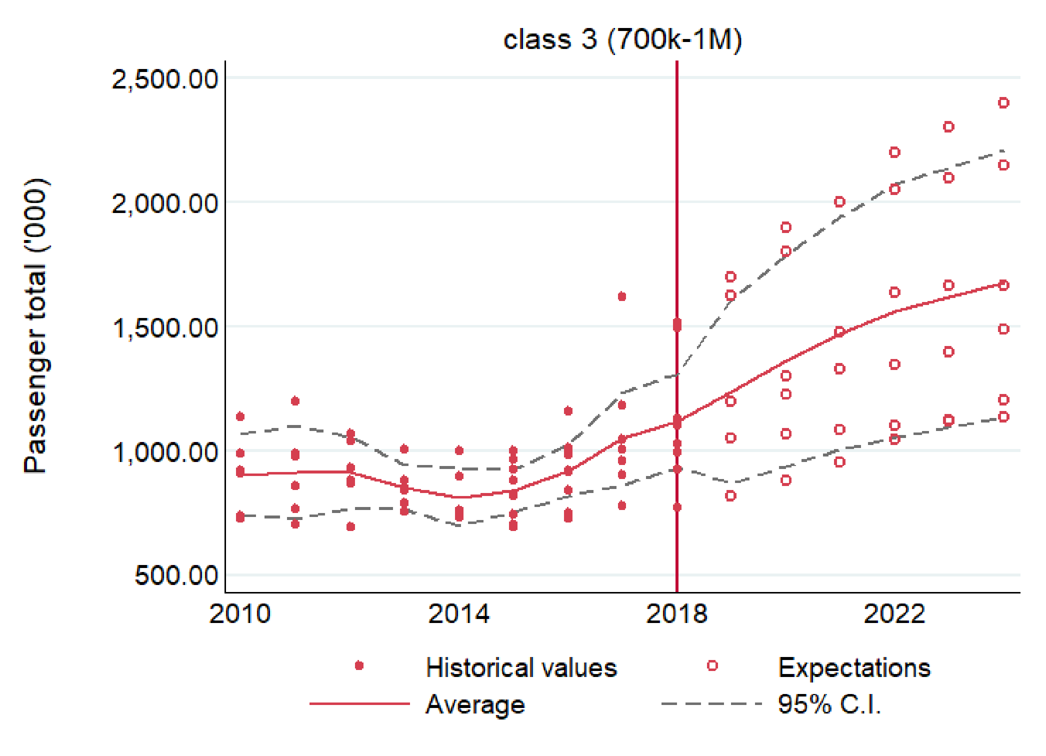
ANNEX E. GRAPHS

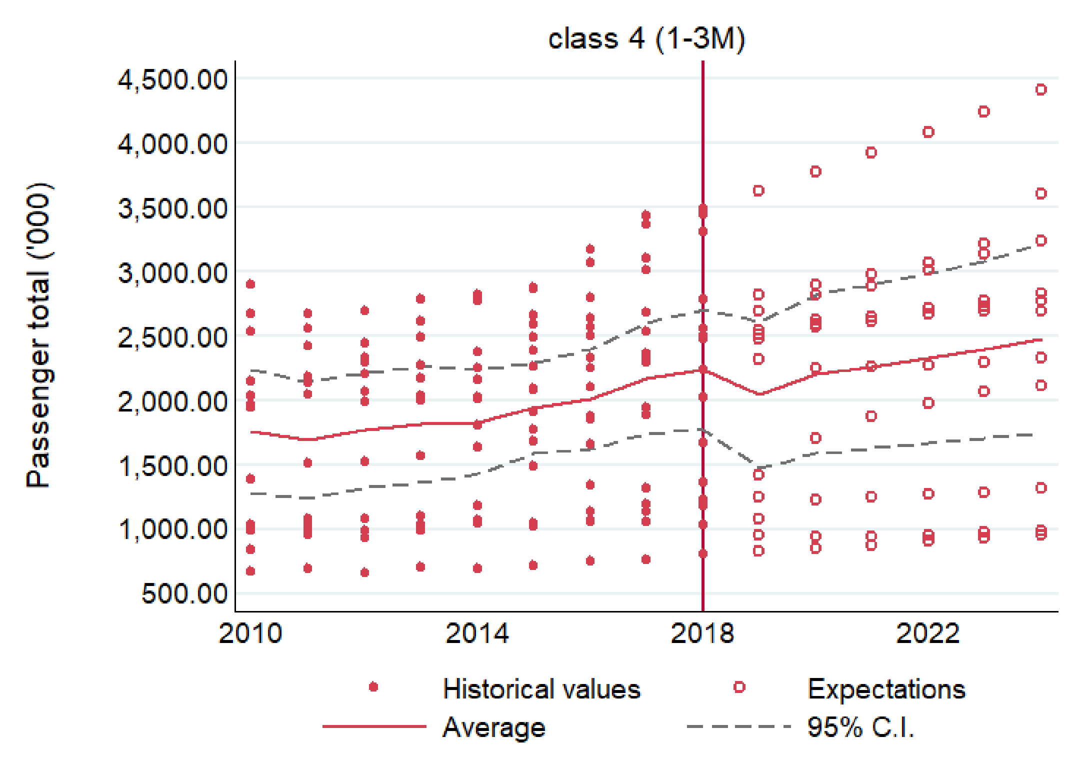
Passenger total traffic by class and year

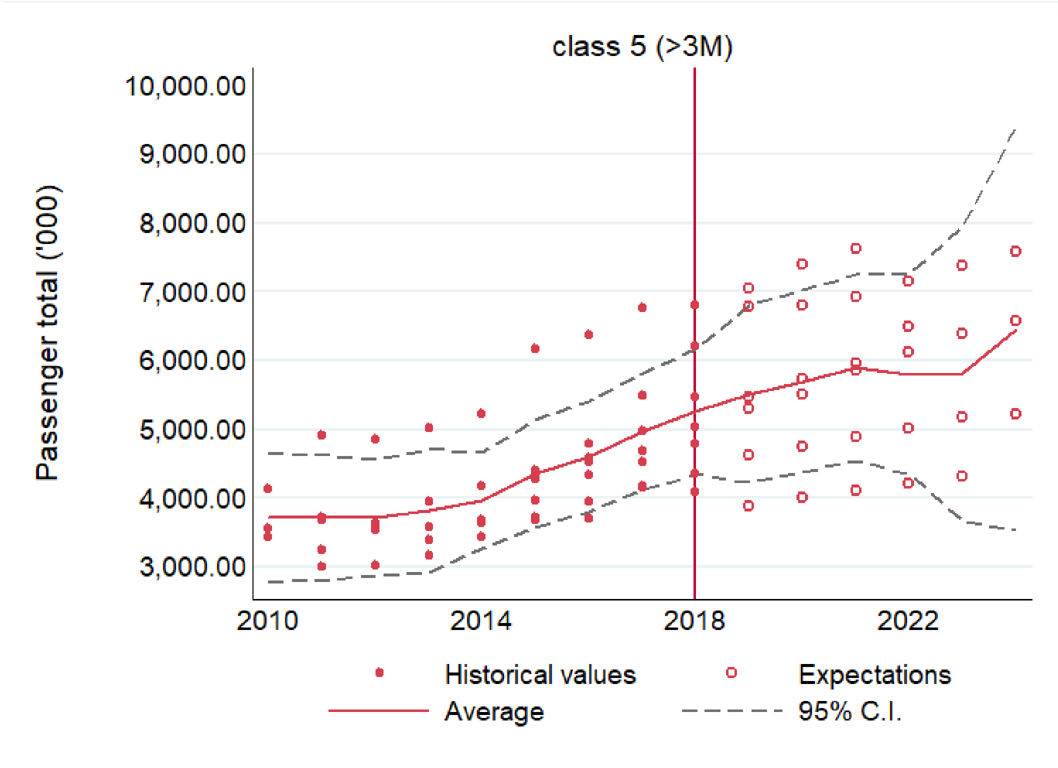
Figure E.1 Passenger total traffic by class and year






class 3 (700k-1M)
Passenger total ('000)
2,500.00
2,000.00
1,500.00
1,000.00
500.00
2010
2014
2018
2022
Historical values
Expectations
Average
95% C.I.

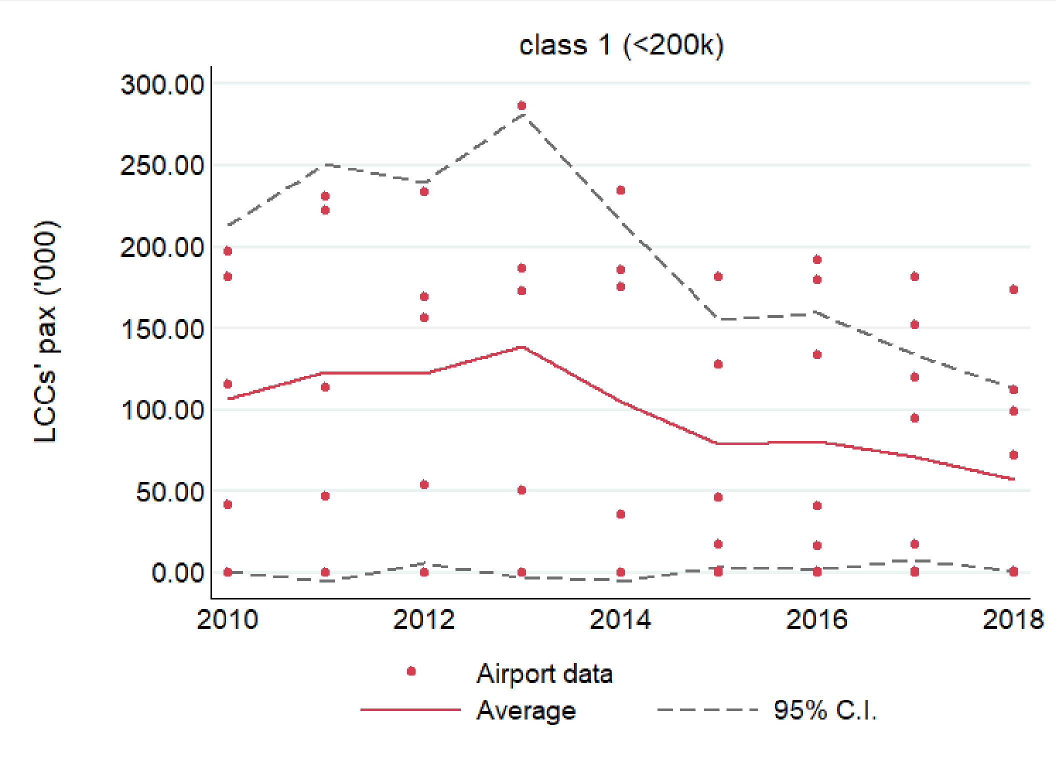

class 4 (1-3M)
Passenger total ('000)
4,500.00
4,000.00
3,500.00
3,000.00
2,500.00
2,000.00
1,500.00
1,000.00
500.00
2010
2014
2018
2022
Historical values
Expectations
Average
95% C.I.



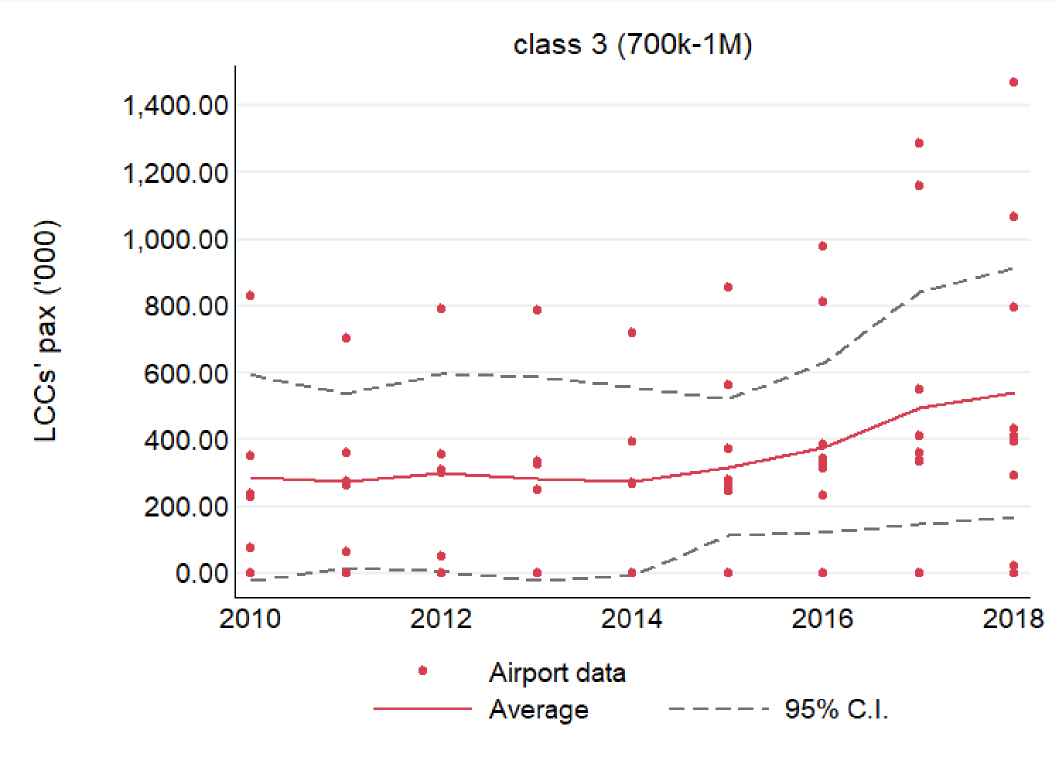
Source: Team based on sample data. Note: Airports' data for 2010-2018 (historical values: solid red circles) and 2019-2024 (expectations: hollow red circles). The average is the red solid line. The 95% confidence interval is indicated by the two black dashed lines. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "k" or ('000) is a shortcut for thousands; "M" for millions.

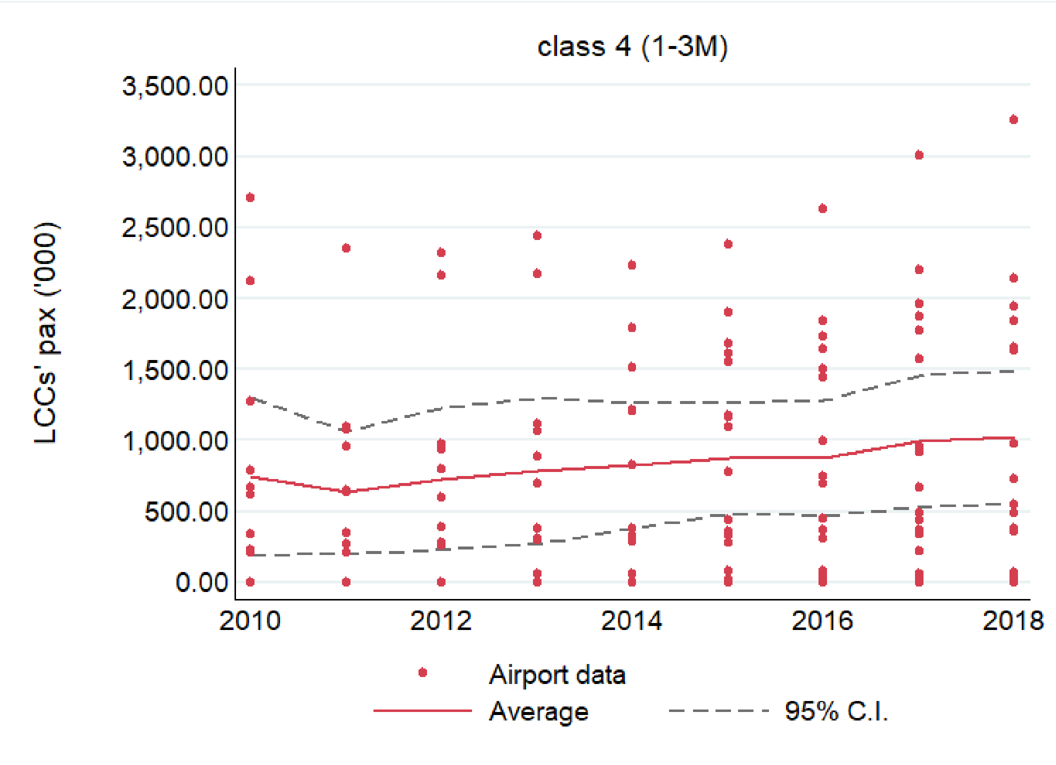
LCCs Passenger traffic by class and year[112]

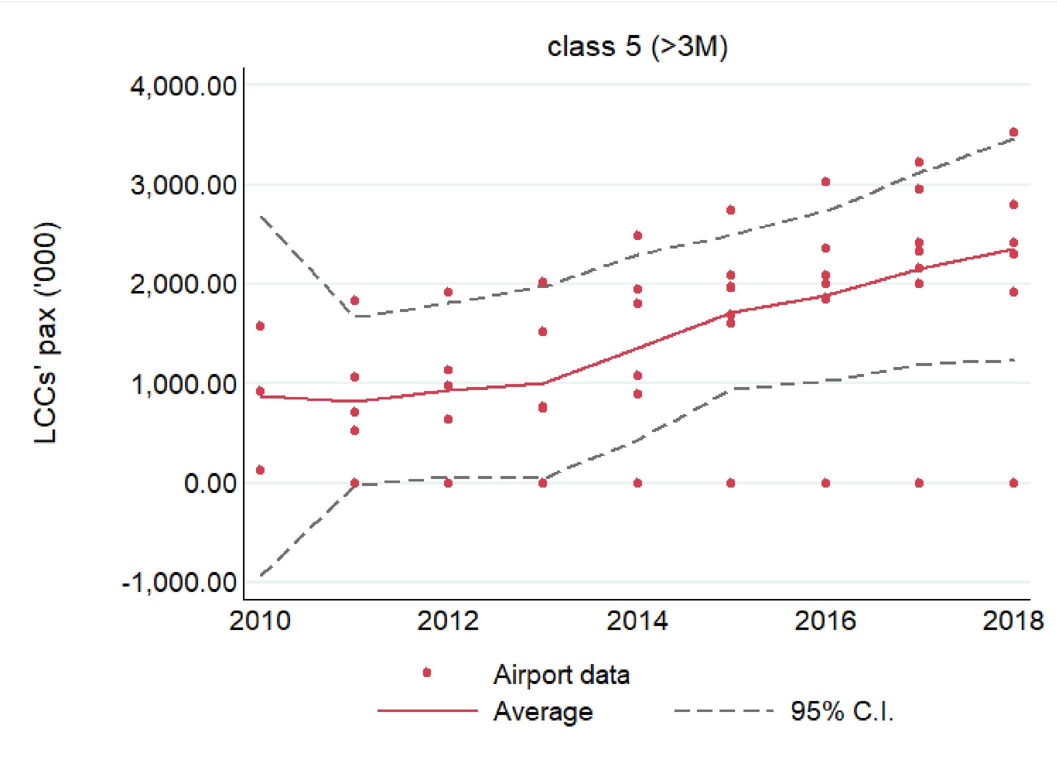
Figure E.2 Passengers from low-cost carriers (LCCs) by class and year



[112] For expectations, there is no data from the survey about passenger breakdown by air carrier type.


class 3 (700k-1M)
LCCs' pax ('000)
1,400.00
1,200.00
1,000.00
800.00
600.00
400.00
200.00
0.00
2010
2012
2014
2016
2018
Airport data
Average
95% C.I.


class 4 (1-3M)
LCCs' pax ('000)
3,500.00
3,000.00
2,500.00
2,000.00
1,500.00
1,000.00
500.00
0.00
2010
2012
2014
2016
2018
Airport data
Average
95% C.I.

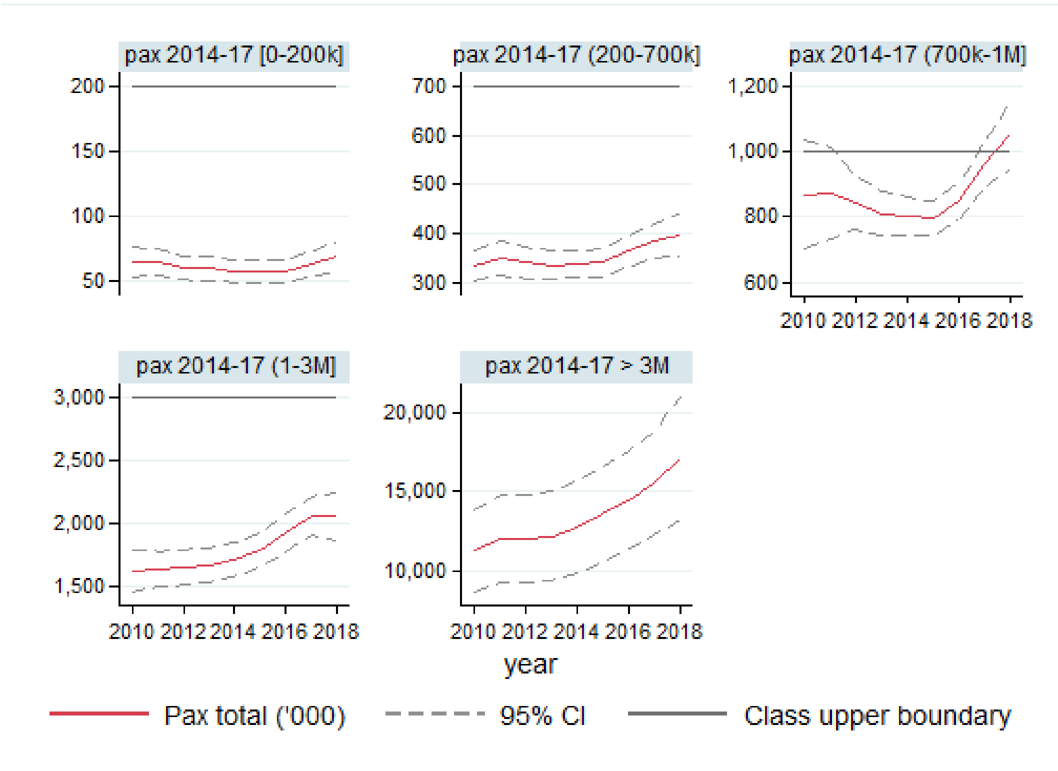


Source: Team based on sample data. The average is the red solid line. The 95% confidence interval is indicated by the two black dashed lines. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "k" or ('000) is a shortcut for thousands; "M" for millions.

Eurostat data on passengers: all EU airports

In Figure E.3, data on all EU airports from Eurostat is displayed. Each EU airport is assigned to a class with the same criteria applied in our sample design, based on passenger data from 2014 to 2017. The figure displays the pattern over time of the average number of passengers by class (and the 95% confidence interval of the estimated mean). In each class' individual graph a horizontal grey line marks the upper boundary of the class definition (e.g. for class 1, defined to contain all airports with passenger traffic up to 200,000 passengers, this is the class' upper boundary). The graphs make apparent that small airports that belong to classes 1 and 2 tend to stay small (i.e. they remain much below the upper boundary of the class; while classes 3 and 4 display a marked average growth toward the upper boundary of their class. For class 5 no upper boundary is defined, but the class average is always a multiple (between 3 and 4) of the class lower boundary. The passenger levels and the time pattern displayed by each class are similar to what is found based on our sample data (passenger levels for class 5 airports in our sample are lower because the sample design has excluded the very large ones, as explained in section 4).

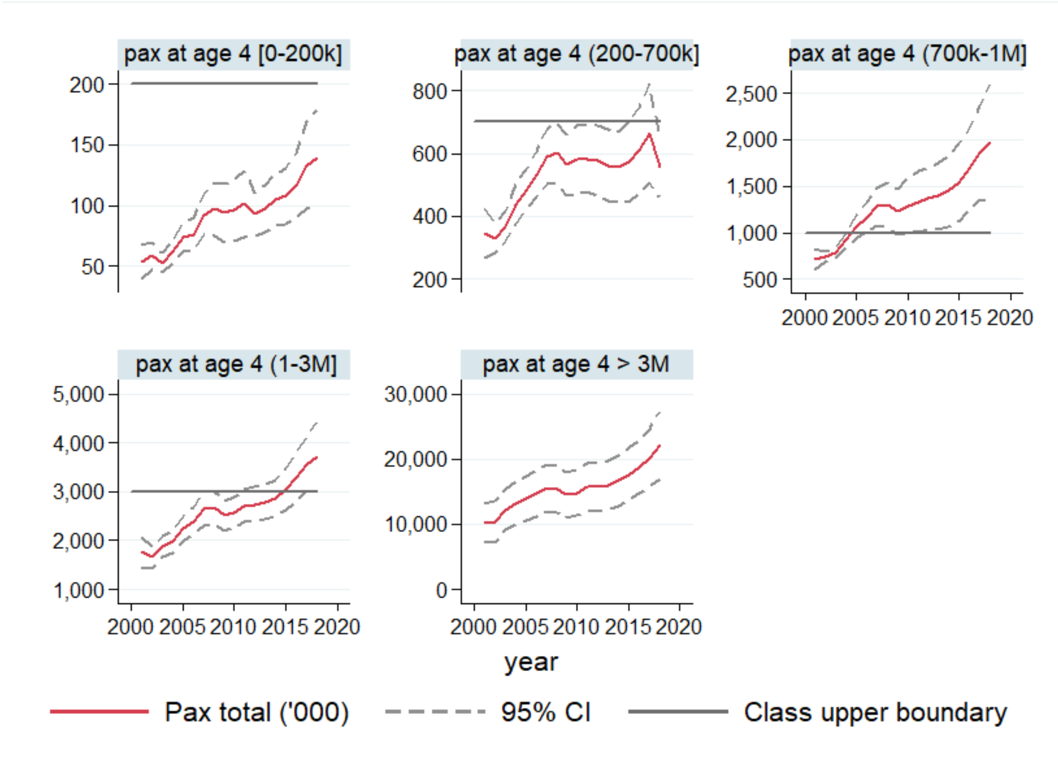
Figure E.3 All EU airports by class assigned in 2014-2017: passenger traffic evolution



Source: Team based on Eurostat data. The average is the red solid line. The 95% confidence interval is indicated by the two dashed black lines. Airports are grouped into 5 classes based on Eurostat data on passengers between 2014 and 2017 (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "k" or ('000) is a shortcut for thousands; "M" for millions.

Figure E.4 looks at passenger patterns starting from an airport's entry size and the same conclusions can be drawn. Each EU airport is assigned to a class with a different criterion with respect to our sample design. In fact, each EU airport is assigned to a class based on its average passenger traffic level in the first five years the airport is observed in Eurostat data with a positive value of passengers (this level is defined as *passengers at age 4* of an airport).

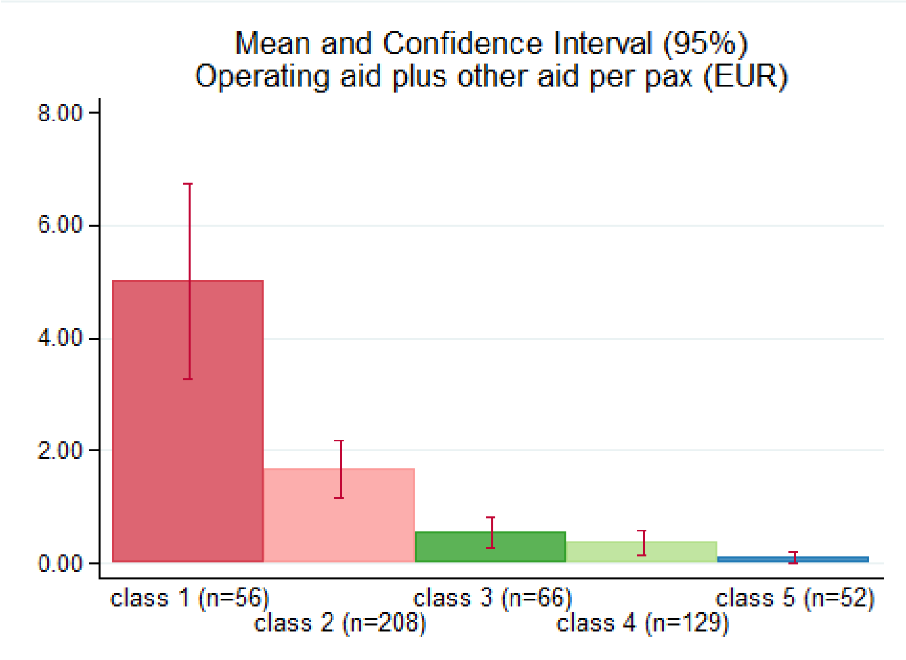
Figure E.4 All EU airports by class assigned at entry: passenger traffic evolution



Source: Team based on Eurostat data. The average is the red solid line. The 95% confidence interval is indicated by the two dashed black lines. Airports are grouped into 5 classes based on Eurostat data on during the first five years an airport has positive passengers in Eurostat data (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). "k" or ('000) is a shortcut for thousands; "M" for millions.

Operating aid and other aid

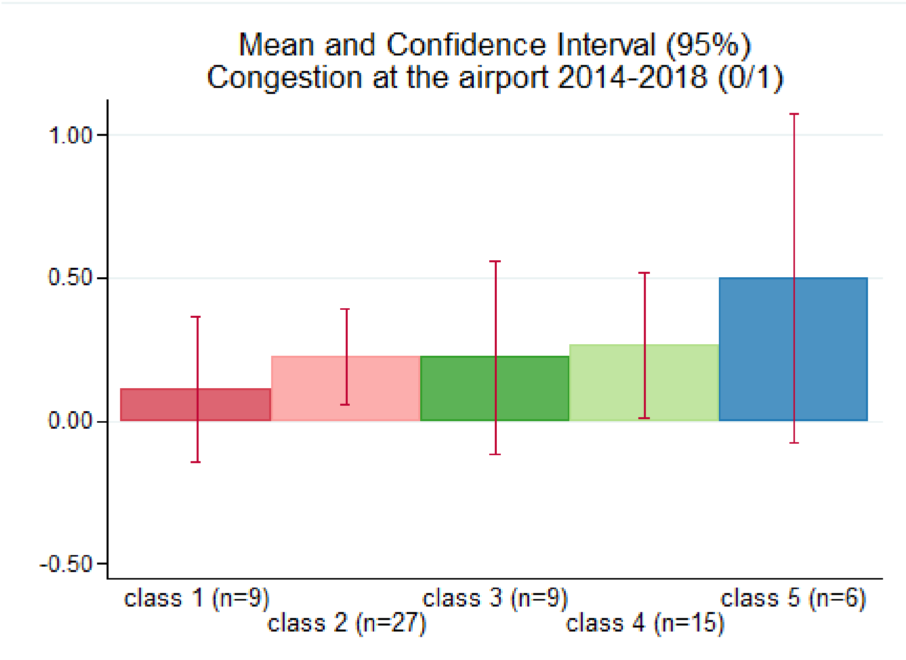
Figure E.5 Amount of operating aid plus other aid per passenger, by class (2010-2018)



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

Congestion at the airport (2014-2018)

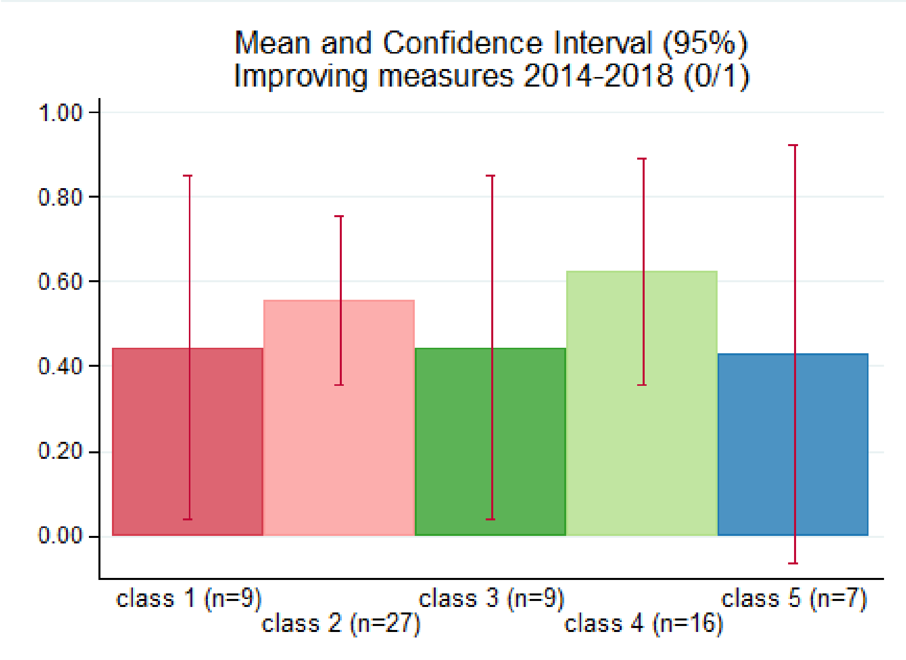
Figure E.6 Airports suffering from congestion at least once, by class (2014-2018)



Source: Team based on sample data. Note: Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations (airport-year for each class). The confidence interval is represented by vertical red lines. (0/1) indicates that the variable "congestion" is a dummy variable (thus the mean indicates the fraction of airports that experienced congestion during the period 2014-2018)*

Measure of improvements (2014-2018)

Figure E.7 Airports experiencing improving measures, by class (2014-2018)

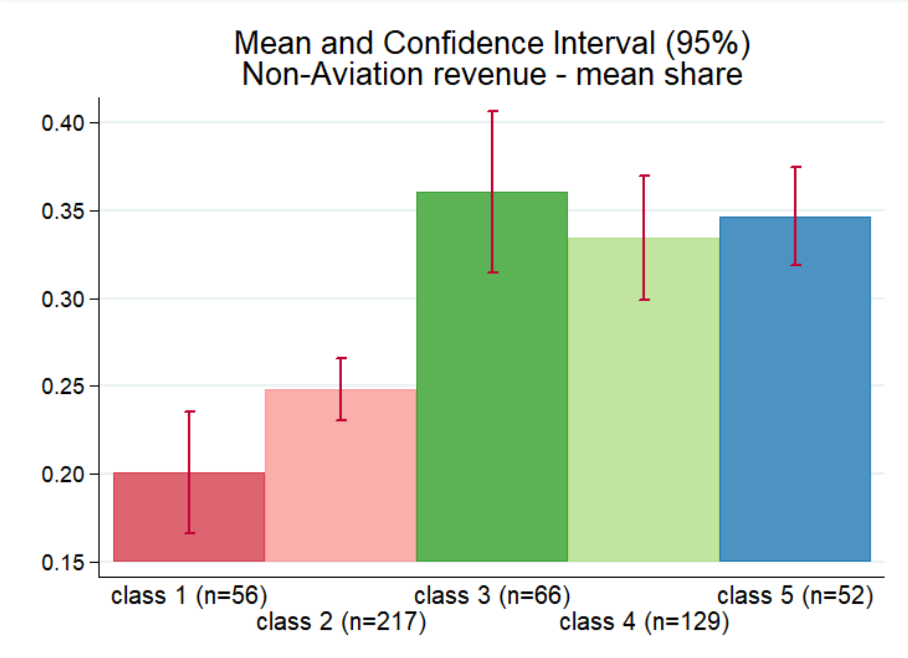


Source: Team based on sample data. Note: Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations (airport-year for each class). The confidence interval is represented by vertical red lines. (0/1) indicates that the variable "improving measures" is a dummy variable (thus the mean indicates the fraction of airports that implemented improving measures during the period 2014-2018)*

Non-aviation revenues

According to the industry consensus, a key indicator of an airport's profitability is the share of non-aviation revenues, that is, the share of non-aeronautical revenues over total revenues. Figure E.8 show the distribution of the fraction of non-aviation revenues by class. The share ranges between 20% (in class 1) to more than 35% (around which class 3, 4 and 5 are clustered). Noticeably, there is a jump of about 10 percentage points between class 2 and class 3, while over larger airports the mean share is more stable.

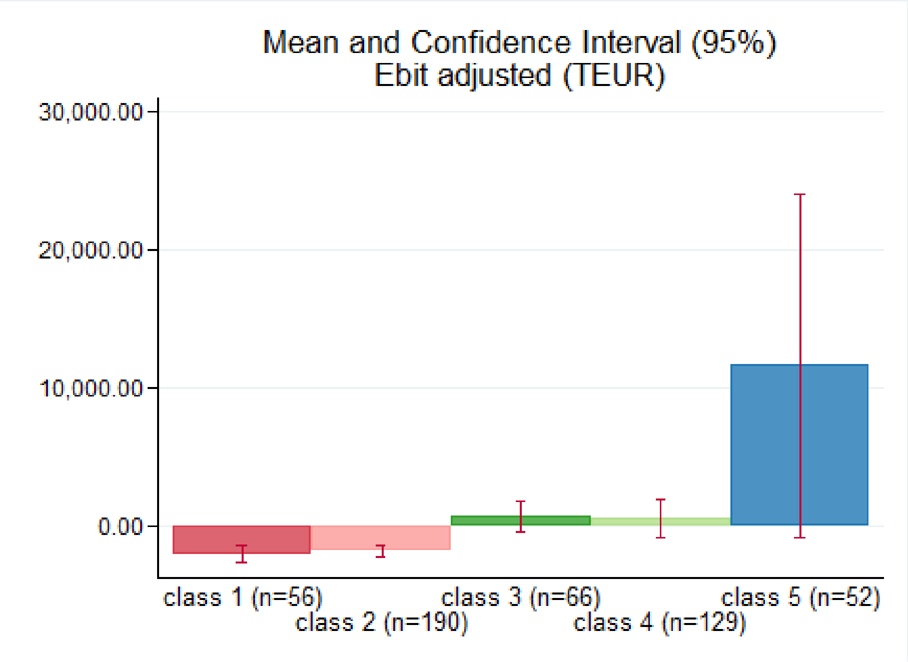
Figure E.8 Non-aviation revenue share, by class



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines.*

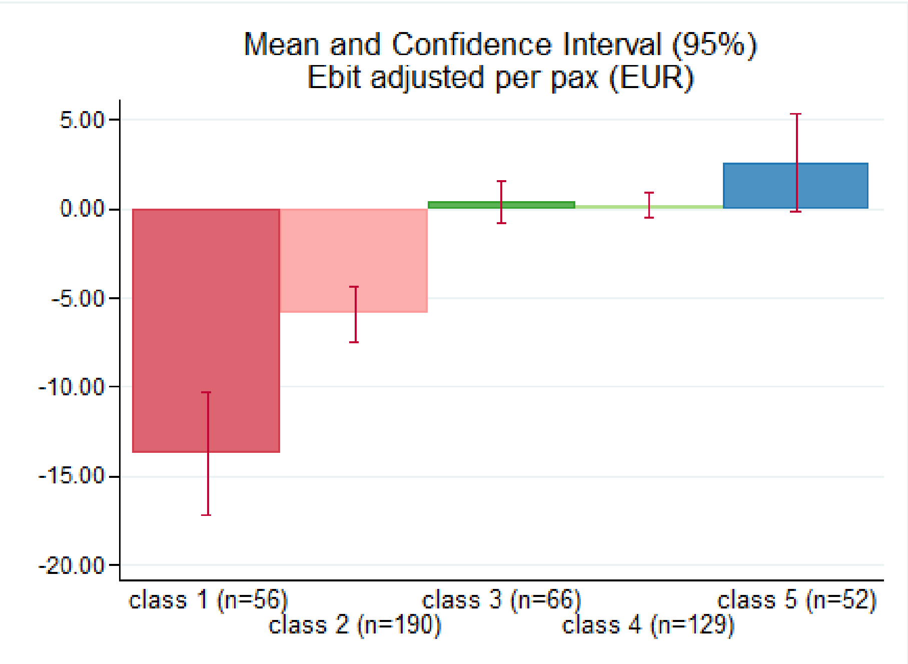
EBIT adjusted for operating aid

Figure E.9 Earnings before interest and taxes adjusted for public resources concerning operating costs (EBIT adjusted), by class



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations in each subsample (airport-year for each class). The confidence interval is represented by vertical red lines. "TEUR" is a shortcut for thousands of Euros.*

Figure E.10 Earnings before interest and taxes adjusted for public resources concerning operating costs (EBIT adjusted): ratio to passengers, by class



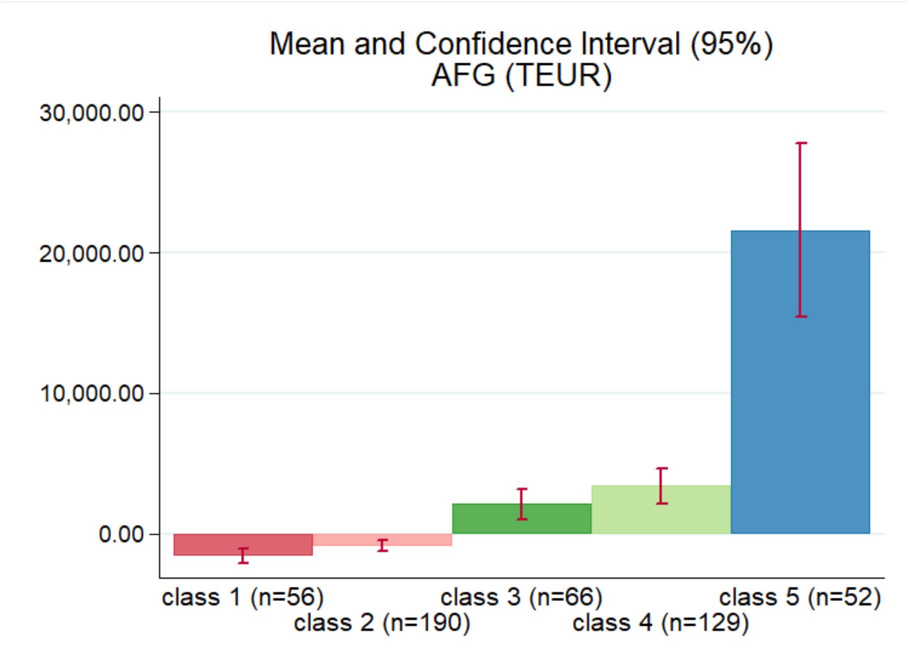
Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5:

>3,000). For each class, n *denotes the number of observations (airport-year for each class). The confidence interval is represented by vertical red lines.*

AFG (Alternative measure of an airport's funding gap)

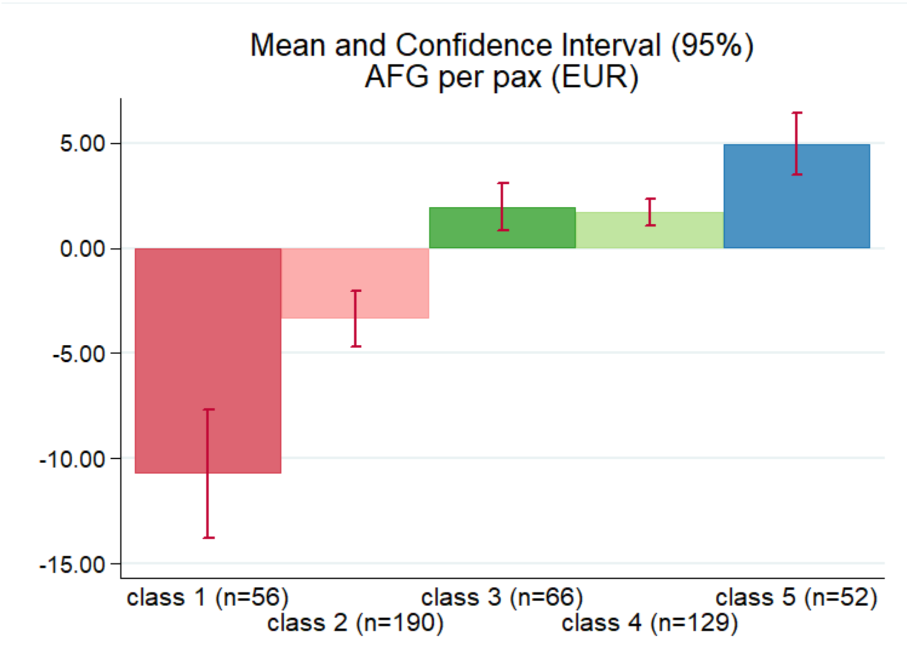
For the definition of AFG see Annex B.

Figure E.11 Alternative measure of the Airports' Funding Gap (AFG), by class



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations (airport-year for each class). The confidence interval is represented by vertical red lines. "TEUR" is a shortcut for thousands of Euros.*

Figure E.12 Alternative measure of the Airports' Funding Gap (AFG): ratio to passengers, by class



Source: Team based on sample data. Note: Statistics refer to the period 2010-2018. Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations (airport-year for each class). The confidence interval is represented by vertical red lines. "TEUR" is a shortcut for thousands of Euros.*

Networks

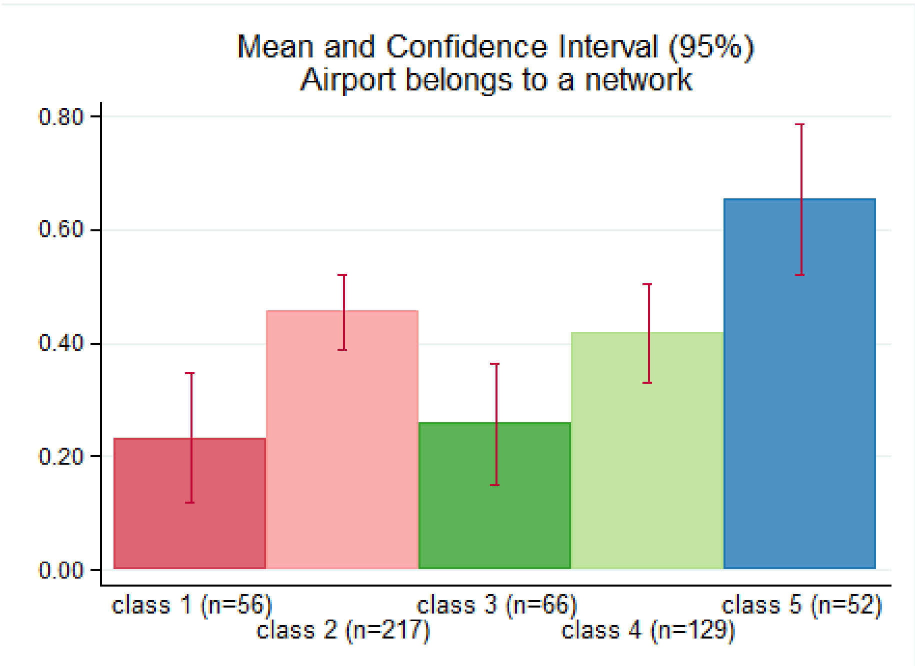
Several airports in the sample belong to a network, that is, are managed by the same airport operator. The variable is built using sample data and desk research. Class 1 airports are less likely managed within a network than other airports: the magnitude is almost double in classes 2 and 4. Most airports are managed within a network in class 5.

Table E.1 Number of airports owned by networks

Networks	Class 1 < 200k	Class 2 [200k-700k]	Class 3 (700k-1m]	Class 4 (1m- 3m]	Class 5 > 3m	Total
Network=Yes	2	15	4	9	6	36
%	25%	55.6%	44.4%	52.9%	85.7%	52.9%

Source: Team based on sample data. Note: Network=Yes if the airport is owned by a network in at least one year.

Figure E.13 Distribution of network's run airport' observations



Source: Team based on sample data and on desk research. Note: Airports are grouped into 5 classes based on passengers (in thousands: class 1: 0-200; class 2: 200-700; class 3: 700-1,000; class 4: 1,000-3,000; class 5: >3,000). For each class, n *denotes the number of observations (airport-year for each class). The confidence interval is represented by vertical red lines. The variable "network" is a dummy variable (thus the mean indicates the fraction of airports that belong to a network during the period 2010-2018)*

ANNEX F. GLOSSARY AND ACRONYMS

Term or acronym	Meaning or definition
ACI	Airports Council International is an association representing airports' interests in dealing with the regulators and airlines
Adequacy of the categorization of airports	The third objective of this Study is to assess whether passenger traffic is relevant and sufficient to identify the variation of airports' financial needs
Adequacy of the transitional period	The second objective of this Study is to assess whether the transitional period (2014-2024) provided under the Aviation Guidelines for the phasing out of operating aid is adequate to let airports achieve a self-sustainable operating performance
AFG	A measure of an Airport's Funding Gap alternative to OFG: it equals airports' operating losses over the relevant period (EBITDA), minus all public resources received to cover operating costs, as well as investment costs not eligible for investment aid
AI	The Accessibility index is the population living in a municipality weighted average travel time to all other municipalities
ATM	Air traffic movements
Average initial OFG	Annual average of the initial OFG
Aviation Guidelines	The Guidelines on State aid to airports and airlines adopted in the Communication from the Commission 2014/C 99/03, which constitute the EU aviation framework applicable as of 2014
BAA	British Airport Authority
Classes	The five-class categorisation the European Commission uses in the Aviation Guidelines to distinguish airports' ability to cover operating costs depending on the number of passengers per year. The classes are: Class 1: 0-200,000; Class 2: 200,001-700,000; Class 3: 700,001-1

Term or acronym	Meaning or definition
	million; Class 4: 1,000,001-3,000,000; and Class 5: above 3 million
CMA	UK Competition and Market Authority
Commission	European Commission
DEA	Data envelopment analysis
Confidence Interval (C.I.)	A range of values so defined that there is a desired probability (e.g. 95%) that the value of a parameter lies within it when drawing a random sample from the population multiple times. It is one method of interval estimation; the larger the interval width the larger the uncertainty of the estimate. In the case of the mean, the two extremes of a 95% C.I. are usually computed as: $\left(m \pm t_{\alpha} \cdot \frac{s}{\sqrt{n},}\right)$ where *m* and *s* are respectively the sample's estimate of the mean and of the standard deviation, *n* is sample size, and t_{α} is an appropriate critical value that demarcates the boundaries of a 95% probability area in a t-Student probability distribution.
DDF	Directional distance function model
EBITDA	Accounting measure of earnings before interests, taxes, depreciations and amortizations
EBIT	Accounting measure of earnings before interests and taxes
EBIT adjusted	EBIT minus after deducting all public resources received to cover operating costs
EU	European Union
FDI	Foreign direct investment indicates investments made by a firm or individual from one country into a business located in another country
FSCs/FNCs	Full-service carriers (or full-network carriers) are companies usually offering three kinds of services: Economy, Business and First Class.

Term or acronym	Meaning or definition
	The ticket price includes often additional services to the flight
GBER	The General Block Exemption Regulation is the regulation of the European Commission establishing categories of State aids exempted, under certain conditions, from prior notification to the Commission
GDP	The Gross domestic product measures the market value of goods and services produced in a certain area in a given period of time
Geographical efficiency	According to (Tapiador, F., Mateos, A. & Martí-Henneberg, J., 2008), it is a measure of how efficiently an airport benefits from its location. It is calculated as the ratio between the location assets of the airport and traffic generated
HCs	"Holiday or leisure carriers are airlines that focus on the transportation of tourists. In the past, the term "charter airline" whilst nowadays, (…) many holiday flights are operated as scheduled, albeit often seasonal services".[113]
HSR	High speed rail is a train transportation service using high speed rail convoys, sometimes in competition with airline services
Initial OFG	Cumulative OFG resulting during the five years preceding the beginning of the transitional period
LCCs	Low cost carriers, i.e. companies offering low cost flights
MSA	A Metropolitan Statistical Area denotes a region with high population density areas at

[113] DLR (2008). Analyses of the European air transport market: Airline business models. December 2008 Release: 1.01. https://ec.europa.eu/transport/sites/transport/files/modes/air/doc/abm_report_2008.pdf (accessed on October 17, 2019).

Term or acronym	Meaning or definition
	its core and strong economic ties among all included territories
NACE	Derived from the French *Nomenclature statistique des activités économiques dans la Communauté européenne*, it refers to the statistical classification of economic activities in the European Community
NDAs	Non-disclosure agreements are agreements through which the parties commit not to share with others some sensitive information
NOK	Norwegian Krone
NUTS 3	The Nomenclature of Territorial Units for Statistics is a geographic subdivision of countries for statistical purposes. Three levels are defined: NUTS3 is the finest level of geographical aggregation
OFG	Operating Funding Gap: airports' operating losses over the relevant period, after deducting all public resources received to cover operating costs
Pax	Passenger(s)
Pilot	Preliminary survey used in the first stages of the Study
PSOs	Public Service Obligations are obligations imposed to a public authority aimed at providing services of general interest
SFA	The Stochastic Frontier Analysis methodology uses deviations from the estimated cost frontier to measure cost inefficiency
SGEI	The Services of General Economic Interest are those economic activities of particular importance to the citizens, which would be undersupplied without a public intervention
Study	Support study for the evaluation of the rules for operating aid under the EU aviation framework applicable as of 2014

Term or acronym	Meaning or definition
Team	The consortium led by Lear and participated by DIW Berlin and Sheppard Mullin that has been awarded the contract to carry out the Study
TFEU	Treaty on the Functioning of the European Union
TS	Tender Specifications
ToR	Terms of Reference (tender document containing the tender specifications)

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