Cost Of Non-Europe in Aviation (CONEA)

ICCSAI

International Centre for Competitiveness Studies in the Aviation

UNIVERSITÀ DEGLI STUDI DI BERGAMO

The ‘Cost of Non-Europe’ in Aviation

(CONEA)

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Contents

1 Executive summary

Over the last few years, the European Commission and the European Parliament have brought forth a number of studies aiming to identify and analyse the 'cost of non-Europe' in ten main areas: (1) the single market; (2) the digital economy; (3) the economic and monetary union; (4) the environment, energy and research; (5) transport and tourism; (6) social Europe, employment and health; (7) citizens' Europe; (8) migration and borders, justice and home affairs; (9) security and fundamental rights and (10) external European Union (EU) policy.

One of the latest studies, 'Europe's two trillion-euro dividend: Mapping the Cost of Non-Europe, 2019-24' by the European Parliament (2019), summarises the evidence found regarding the cost of non-Europe in different policy fields.

Although aviation is included in the cluster 'transport and tourism', thus far, no comprehensive studies have evaluated the cost of non-Europe derived from the aviation market's lack of complete unification. This dearth exists for two main reasons. The first is that the incomplete unification of the aviation industry (an economy enabler) at the European level influences many other areas; these include the free movement of people and international trade (the single market), the environment, migration, border controls and passengers' rights. The second reason is that previous studies have focused on specific components related to the cost of non-Europe in aviation (CONEA), while generally missing a complete overview of its direct effects on the industry, and its broader impact on European economic and social welfare.

Airlines for Europe (A4E) has commissioned the International Center for Competitiveness Studies in the Aviation Industry (ICCSAI) to gather findings from the existing literature in order to thoroughly assess the effects of aviation's incomplete unification from an industry perspective, as well as from the angle of European economic and social welfare.

In this study, we consider five areas as sources of inefficiency in the aviation industry and the overall economy, due to the lack of harmonisation/unfinished unification of the European aviation market. Table 1 summarises the results.

The annual overall impact of non-Europe on the aviation industry, pertinent to five spheres of interest, **ranges from €7.4 to €13.9 billion.**

Considering the socio-economic impact of non-Europe in aviation – including additional time-related costs for travellers, environmental expenses and wider economic benefits – **the amount ranges from €10.9 to €37.1 billion per year**. The annualised estimations are representative of the average annual effect for the next 15 years.

Table 1 – CONEA. Summary of previous estimations for the five different areas (annual values)

Annual values	Yearly impact for the aviation industry (€m)		Yearly overall impact (industry + socio-economic impact) (€m)	
Area of investigation	**Min**	**Max**	**Min**	**Max**
1-European airspace and the application of Single European Sky	4,480	8,090	9,400	17,400
2-Airport charges	1,200	2,000	1,200	2,000
3-Aviation taxes	1,700	3,800	0*	16,700
4-Border control	n.e.	n.e.	339	1,000
5-Union Customs Code	n.e.	n.e.	n.e.	n.e.
Total Impact	**7,380**	**13,890**	**10,939**	**37,100**

* In the absence of empirical evidence, the zero impact on gross domestic product (GDP), based on fiscal neutral assumption, still appears to be an unlikely scenario. n.e. = not estimated

Table 1 presents estimation ranges. The most important component is related to European airspace and the application of the Single European Sky (SES) initiative (see Figure 1), whose lack of harmonisation produces an annual overall economic effect between €9.4 and €17.4 billion (from €4.5 to €8.0 billion in terms of the impact on the aviation industry). The most relevant features are linked to cost savings, including time- or fuel-efficient routes, capacity constraints, other cost inefficiencies, higher travel times for passengers, environmental expenses and broader economic benefits.

A further significant aspect is tied to airport charges. Completely applying the directive on setting airport charges could reduce charges applied in specific countries by an annual value between €1.2 and €2 billion, thereby generating savings for airlines and passengers and improving competitiveness.

Abolishing country-specific aviation taxes could trigger a positive annual impact from €1.7 to €3.8 billion for the aviation industry. Regarding general economic and social consequences, the reports we reviewed widely diverge, from a zero-net impact to €16.7 billion per year. Some studies (European Commission, 2019b) apply a neutral fiscal policy assumption, such that savings from less aviation taxes are assumed to be compensated by increases in other taxes, or by decreases in public spending, with a net neutral effect on the economy. However, the neutral fiscal policy is considered to be an ex-ante assumption and has not been subjected to ex-post verification. Given the divergence of the findings, we believe that the outcome determined by using the fiscal neutral policy assumption should be corroborated with stronger empirical evidence.

We report an estimated cost of non-Europe related to aviation border controls from €339 million to €1 billion per year for the general economy. The elements of this approximation are linked to additional time costs for passengers involving the temporary re-introduction of border controls in the Schengen area, as well as higher times and expenses for border controls and visa policies for air travel to non-Schengen regions. In this realm, it was not possible to identify estimations tied to the impact on the aviation industry.

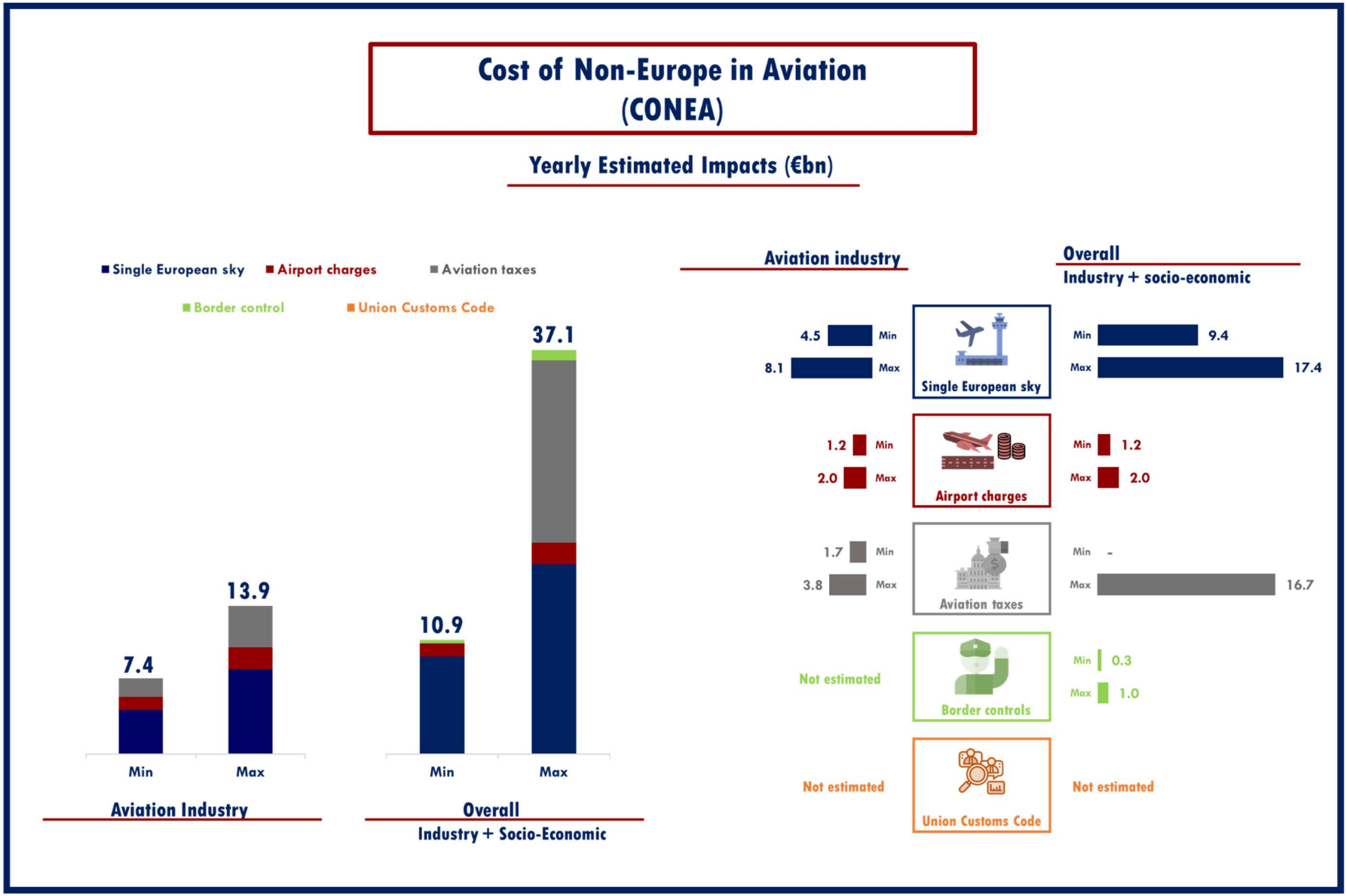

Figure 1 – CONEA. Min-max annual impacts for the aviation industry and the overall economy, related to the five different areas of interest (annual values –€m)

In the area of the Union Customs Code (UCC), CONEA has not yet been quantified, although prior studies widely acknowledge its relevance.

The next paragraphs briefly describe the five areas analysed.

1. **European airspace and application of Single European Sky initiative**

The European Organisation for the Safety of Air Navigation (EUROCONTROL) has pointed out several inefficiencies that directly and indirectly affect EU aviation markets due to the lack of harmonisation/complete unification of the aerospace management system. One major issue involves the greater flight distances that aircrafts undertake compared to what they would fly if they could follow the user-preferred trajectory (UPT) between departure and destination airports, thus leading to extra travel time for passengers and freights, as well as extra fuel consumption and pollution.

The influence of non-Europe in this sphere is tied to: inefficient operations and environmental impacts resulting from extra fuel consumption; lower air traffic management (ATM) productivity and higher charges; capacity constraint effects; airlines' operational costs due to extra time (fuel costs, efficient operations and the ability to maximise airlines' productivity); costs associated with delays and non-unified technology (training, safety, procedures); and costs for passengers (out-of-pocket expenses, time costs and a lower level of services).

In fields involving technology, a key problem is the difficulty of separating the positive effects linked to unifying technology from those related to modernising it, which could at least be partially obtained, even without successful unification. However, in the case of technology that supports European airspace management (AM), the high fixed costs of introducing the latest technology increase the minimum scale necessary to make its introduction economically feasible. Furthermore, the asymmetric introduction of new ATM technology among EU member states could produce transaction costs and reduce their net benefits.

2. Airport charges and regulatory processes

Although a European directive on airport charges has been in place since 2009, its application varies widely between EU member states, which have interpreted and implemented it differently. For example, some have granted more or less power to regulators, while others have let regulators impose economic rules. This lack of harmonisation affects the level of airport charges, which in some cases are estimated to be even higher due to the regulation setup adopted by some member states. Moreover, the directive established a process-oriented framework (involving consultation and transparency) so that the regulations member states have adopted are their own choice.

Other possible impacts in this area regard potential effects caused by the lack of transparency in setting charges, the different rules of engagement and procedures from the national Independent Supervisory Authority (ISA), the link between concession agreements and airports' framework for determining charges, as well as costs (administrative costs, uncertainty, delays in decision-making) arising from consultation processes.

3. The lack of a homogeneous tax scheme and the presence of different ad hoc aviation taxes

European aviation does not have a uniform taxation regime. In many countries, specific taxes and charges vary depending on ticket taxes, value-added taxes (VATs), taxation on aircraft fuel, environmental taxes and taxes for air cargo. The presence of different tax schemes in EU member states generates extra costs for the continent's aviation industry. In this study, we focus on effects resulting from the presence of ad hoc aviation taxes, which could reduce total intra-European demand, and the increasing administrative burdens on both airlines and airports.

4. **Re-introducing border controls**

Introducing border controls remains a member state prerogative. The Schengen Borders Code allows for the short-term re-introduction of controls at internal borders for serious threats to public policy or internal security. Since 2015, several controls, both landside and in the aviation industry, have been temporarily re-introduced.

These changes typically affect airline operations since they can generate extra direct costs required to be compliant with provisional rules. They necessitate extra time and consequently lead to more inefficient schedules. They also impact passenger direct time and cost of travel, with adverse effects on the level of demand.

5. **Implementing the Union Customs Code**

After the UCC legal package came into effect in May 2016, attempts to standardise customs information and processes have played a key role in homogenising practises. Potential deviation from completely unifying the European aviation system implies disorganisation and extra expenses. Executing fully electronic customs within a non-homogeneous framework could cause inefficiency costs due to: (1) higher customs times and costs for freight operators and their customers; (2) greater compliance and transaction costs for airports and airlines (due to a heavier administrative burden); (3) safeguarding the financial and economic interests of the EU and its member states and operators; and (4) sub-optimal choices by freight operators in terms of network configuration and service levels.

Assessment

For each area we consider evidence from the literature, which can be broadly classified into the following sources:

- Academic scientific literature (large databases of peer-reviewed literature, such as Scopus and Web of Science)
- Policy papers released by the European Commission's Directorate-General (DG) for Mobility

and Transport

- Databases of EU projects
- EUROCONTROL
- Other sources (the International Air Transport Association [IATA], Airports Council International [ACI] Europe, A4E, reports from consulting companies).

Several reports and investigations refer to other original sources or are previous versions of more updated analyses. In those cases, while including all available documents in our study, the final estimations are based on the more recent sources.

We take into account all independent estimations made regarding the cost of non-Europe for the areas of interest. Some calculations resulted in different estimations for the same effects due to applying different methodologies, scenarios or underlying assumptions. **We do not question the validity of the different evaluation processes,** and we include minimum and maximum ranges to account for variability in the estimations of each component.

2 European airspace and application of the Single European Sky initiative

One primary issue concerning CONEA, mentioned earlier, relates to the inefficiency arising from the lack of harmonisation and/or complete unification of the aerospace management system. This section evaluates the economic costs associated with the existing fragmentation among Air National Service Providers (ANSPs) in Europe. First, we review some of the most pertinent studies, policy reports and scientific articles produced on the topic in recent years[1]. Second, we highlight their differences to obtain a reasonable estimate of the costs associated with the fragmentation of European airspace.

2.1 Main documents analysed

In this section, we review the following contributions in terms of estimations, valuations and assumptions:

- *'A proposal for the future architecture of the European airspace' (SESAR, 2019):* This includes the Single European Sky ATM Research (SESAR) proposal of 2019, the European ATM Master Plan (SESAR, 2015) and the Pilot Common Project (SESAR, 2013). The SESAR Joint Undertaking (SJU) represents collective efforts to coordinate and concentrate EU research and development activities in ATM, thereby providing a general analytical framework and a comprehensive assessment of the relevant costs of non-Europe.
- '*Economic benefits of European airspace modernization' (SEO, 2015):* This study was prepared by SEO economics to quantify the benefits of ATM modernisation from a welfare

[1] The selected works reveal relevant details of methodology, thoroughly explain assumptions and provide a final evaluation. However, other studies we reviewed lead to more or less consistent and simplistic estimates (e.g. IATA, 2013).

perspective. This study departs from SESAR's assumptions and adds some quantifications based on welfare from a passenger-centric standpoint.

- *'The impact of fragmentation in European ATM/CNS' (Helios, 2006):* This study was commissioned by EUROCONTOL's Performance Review Commission (PRC). It clarifies the central components of cost savings related to unification.
- *'Study on the current level of protection of air passenger rights in the EU' (Steer, 2020):* This study determines the cost of implementing Regulation 261/2004, partly due to air traffic flow management (ATFM) delays generated under the SES initiative.
- '*Digitalising Europe's aviation infrastructure*' *(European ATM Master Plan, 2020):* This paper outlines SESAR's most updated analysis.
- *Scientific literature:* Academic publications recap the chief scientific methods used to quantify the impact of non-Europe on ATM.

SESAR (2019)

‘A proposal for the future architecture of the European airspace’

‘A proposal for the future architecture of the European airspace’ (SESAR, 2019) departs from the European Master Plan 2015 assessment and gauges the value of implementing the SES initiative under current conditions. The Single European Airspace System (SEAS) proposed in the project is an evolution of the European airspace architecture, which leverages modern technologies to decouple service provision from local infrastructure. It aims to optimise airspace configuration and design a consolidated European network, considering major traffic flows and constraints across Europe.

The SESAR proposal evaluates the net benefits, taking four key performance areas (KPAs) into account:

- **Capacity**: The effect on capacity is addressed through two assessments of: (1) the reduction in delays associated with the increase in capacity, scalability and resilience that follows the airspace re-organisation of the SES transition strategy, as highlighted in the Master Plan; and (2) the potential resilience brought about by the re-organised architecture in mitigating delays caused by problems with staffing, disruptions, planned events and weather.
- **Environment**: The impact on the environment is determined by considering improvements in fuel efficiency linked to the increase in horizontal flight efficiency thanks to seamless European Civil Aviation Conference (ECAC)[2] free route airspace (FRA), optimised airspace re-organisation and the implementation of 4D trajectories.
- **Cost efficiency**: This influence is tied to the cost efficiency benefits of air national service (ANS) productivity improvements. The evaluation addresses the enhanced average sector load, along with increased capacity and flexibility. The impact on cost efficiency does not

[2] An intergovernmental organisation that promotes the continued development of a safe, efficient and sustainable European air transport system.

include cost savings linked to rationalising and optimising CNS (Communication, Navigation and Surveillance) or structural changes in ANSP models.

- **Safety**: No economic assessment is performed.

SESAR's assessment (2019) was carried out by considering a set of assumptions that in principle depart from SESAR's Master Plan 2015 evaluation (the Appendix details all evaluations and assumptions of the Master Plan [SESAR, 2015] and the Pilot Common Project [SESAR, 2013]).

- **Area of investigation:** ECAC region
- **Period of forecasts:** 2019-2035

Table 2 – The main assumptions of the SESAR (2019) proposal

Dimension	Value	Source
Traffic forecast	Regulated growth scenario as in the Master Plan High-growth scenario predicts an average flight growth rate of 2.7% for 2018–2035 (17.3 million flights by 2035 – a total increase of 64%)	Statfor
Average fleet size	13,600 (2017) and 22,500 (2035)	EUROCONTROL
Average cost of one-minute delay	€70	EUROCONTROL
Number of sectors	690	SJU estimate
Number of area control centres	65	Assumptions on EUROCONTROL estimates
Future number of ADSPs (ATM Data Service Providers)	10	SJU estimate
Number of ANSPs	25	Assumptions on EUROCONTROL estimates
Discount rate	7.3%	SJU estimates
Average fuel burned per nautical mile	11 kg	EUROCONTROL
Price of fuel	€0.31/kg	EUROCONTROL

Evaluations are conducted considering two scenarios, both for the lower and upper ranges, where the former (latter) considers the lower (upper) bound assumptions (e.g. a lower [greater] reduction in nautical miles, as suggested by Network Management (NM) — EUROCONTROL simulations). The overall outcomes of the economic analysis indicate that it is possible to achieve a substantial potential benefit of €42 to €47 billion over the 2019-2035 period (Table 2). In detail, SESAR's estimates highlight that (Table 3 and Figure 2) the effect on capacity, in terms of reducing delays, comprises a large share of the overall benefit (72% to 81%), followed by improved ANS productivity (up to 12% in the upper range scenario: €7 billion between 2019 and 2035). Considering the estimated decrease in nautical miles due to optimised trajectories, we would expect reductions ranging from 240 kg to 450 kg of CO_2, corresponding to €3 to €6 billion during the specified period.

Accounting for all investments implemented during the period (a cumulative cost that might vary from €7.6 to €12 billion, along with the performed estimates: ECAC-wide airspace redesign, 4D services, a next generation performance-based air-ground communications environment, etc.), and considering a discounted rate of 7.3%, the overall net present benefit ranges from €13 to €17 billion. On a yearly basis, in 2035, economic benefits are estimated to equal €5.7 to €6.2 billion, with the net benefits being equal to €5.6 to €6.1 billion (€0.1 billion in investment costs).

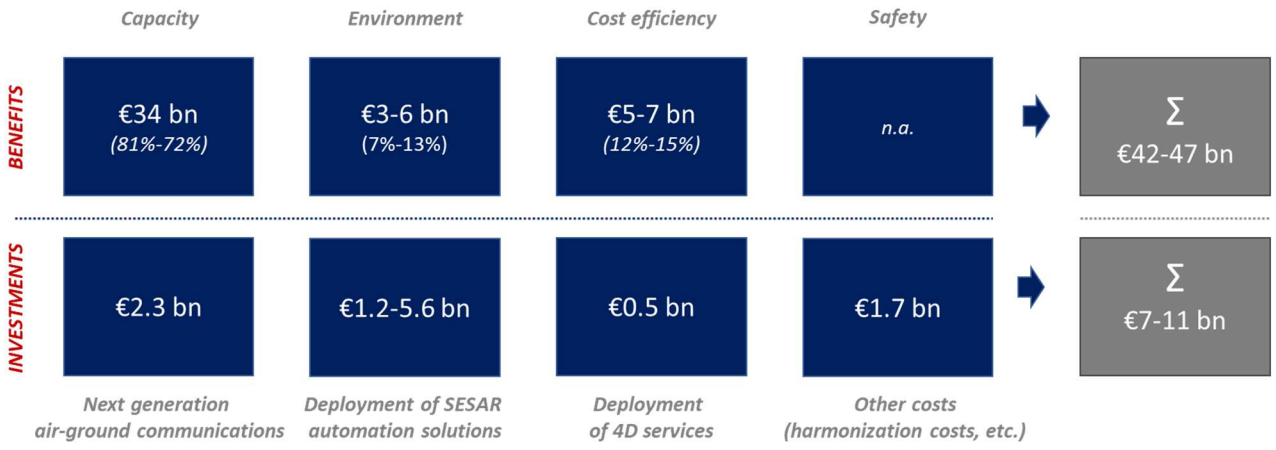

Figure 2 – SESAR estimates by KPA, 2019

Table 3 – The economic benefits per SES KPA (SESAR, 2019)

KPA	Goal	Benefit	Value (€bn)	%
Capacity	Network able to accommodate a target of 15.7mpax and reduce delay per flight to 0.5 min due to full implementation of the transition strategy			
	• Master plan performance ambitions	Reduction of 438mof minutes		
	• Additional resilience for reduced delays caused by staffing, disruptions, planned events ad weather	Reduction of 38mof minutes	34	81%-72%
Environment	• Increased horizontal flight efficiency (seamless ECAC FRA) and optimised airspace re-organisation	Reduction from 7 to 13 miles in 2035 and 4 to 10 in 2030	3-6	7%-13%
	• 4D trajectories	Increased fuel efficiency of 0.02%		
Cost efficiency	• Improvement of ANS productivity	Increase in average sector load from current 62% to 70% in 2030 and 90% in 2035	5-7	12%-15%
	• Increased ANSP productivity due to 4D trajectories	+ 1.25% in productivity (Master Plan estimate)		
Safety	No economic assessment		n.a.	n.a.
Total			**42-47**	

SESAR (2019) conducts a sensitivity analysis to test the robustness of the economic analysis under different assumptions. Three different scenarios are considered, involving: (1) greatly reduced delays (a decrease of 8 minutes rather than 4 minutes per flight – Network Manager EUROCONTROL estimates); (2) a higher increase in the traffic forecast compared to baseline figures (Network Manager EUROCONTROL, 7-year forecast), where flights increase at a rate of 2.3% from 2018 to 2024 and 3.1% from 2024 to 2035 (a high-growth scenario); and (3) doubling the overall amount of investments, from €14 to €22 billion. Additional net benefits are as follows:

1. Reduced delays: Net benefits increase by €35 billion (2019 to 2035)
2. High-growth scenario: Net benefits increase by €3 billion

3. Doubled investments: Net benefits decrease by €11 to €7 billion

Sensitivity analyses show that taking into account more optimistic scenarios (greatly reduced delays and more traffic), the overall benefit increases substantially (up to nearly €40 billion during the period), while a prediction of doubled investments might decrease net benefits from €31 to €40 billion (the baseline scenario) to €20 to €30 billion, thus still demonstrating that investing in SES modernisation and harmonisation will be essential and helpful for European aviation.

SEO (2015)

‘Economic benefits of European airspace modernization’

SEO Amsterdam Economics conducted a study commissioned by IATA (2015) to independently discern the economic benefits of European airspace modernisation and airport capacity enhancements. In terms of evaluating the cost of non-Europe regarding the integration of air traffic management systems, only airspace modernisation appears to be relevant, since the removal of airport capacity constraints are not directly linked to industry centralisation.

Airspace modernisation is expected to deliver the following benefits, which are quantified using a welfare approach for European passengers:

- **More efficient air navigation services:** airline cost savings and lower airfares
- **Time and reliability savings:** shorter travel times (more direct routings and fewer delays)
- **Connectivity growth:** more routes and a higher frequency of flights
- **Wider economic benefits:** agglomeration effect and higher productivity levels
- **Lower emissions.**

Table 4 – Results of the benefits of European airspace modernisation

Areas evaluated	Description	2035 (€bn)	2015-35 (€bn)
Impact on travellers	Passenger utility, comprehensive regarding all effects that are passed on (less fly time, fewer delays, more options)	32.4 Of which: • 11: Connectivity • 8: Cost savings • 8: Capacity • 5: Time savings	139
The environment	Impact of higher/lower CO_2 emissions	-3.7	-20
Wider economic impact	Economic benefits, which are not captured in direct user benefits, after allowing for environmental costs	1.7	+7

Table 4 depicts the undiscounted values for the period of 2015 to 2035 and in 2035, respectively. The welfare approach, employed to quantify the benefits of airspace modernisation, takes the airspace user's perspective, thereby assuming that all cost savings at the ANSP level (or any other form of cost reduction) will translate into airline cost savings and lower airfares. Travellers will benefit from shorter travel times due to less tortuous flight routings and reduced delays.

Based on the SESAR ATM Master Plan (SESAR, 2015), SEO assumes that the average flight time will have decreased by 4.5% (around 6 minutes) in 2035. Similarly, delay reductions are estimated according to the SESAR ATM Master Plan, and the time values are derived from the harmonised guidelines for determining the costs and benefits of transport investments and policies (HEATCO, 2004); these are further adjusted by country and travel motive (leisure versus business). Due to difficulty obtaining information on the distribution of non-European passengers and their time values, the impact of time savings is only computed for European customers.

Cost savings are calculated on a per flight basis and encompass the following components: (1) lower ANSP costs, as reported in the SESAR ATM Master Plan; (2) savings in maintenance, aircraft and

crew costs (assumed to equal €36.9 per minute) due to reduced travel time; (3) reduced fuel costs because of more direct trajectories; and (4) fewer delay costs, all following from assumptions detailed in the SESAR ATM Master Plan (see the Appendix). Compared to the do-nothing scenario, modernisation will increase the capacity of European airspace. As a result, more travel alternatives will be provided and in general, air transport supply will improve, thus benefiting passengers by providing higher connectivity. Moreover, a higher capacity will decrease the amount of unaccommodated demand. These effects are determined based on the NetCost model (e.g. Lieshout and Matsumoto, 2012; Lieshout, 2012; Lieshout et al., 2016; Veldhuis and Lieshout, 2010) and use a 'generalised travel cost' elasticity of -1.5 and -0.5 for business and leisure passengers, respectively. Based on the 'rule-of-half', this approach allows the computation of benefits for passengers that are already travelling but will enjoy a lower generalised travel cost, as well as passengers not currently travelling by air.

The societal cost of aviation emissions on climate change is determined using a value of €90 per ton of CO_2 (European Commission study — Ricardo-AEA, 2014), which is assumed to be increasing over time by using a smaller discount rate. The overall environmental impact is negative due to the increase in traffic (Table 4), which will likely offset the positive outcome of more efficient flight profiles. Wider economic benefits are indirect ones passed on to other sectors of the economy, such as agglomeration effects. These benefits are estimated to range between 0% and 30% of the effects on aviation users.

HELIOS (2006)

‘The impact of fragmentation in European ATM/CNS’

This study was commissioned by the EUROCONTROL’s PRC and prepared by Helios Economics and Policy Services in 2006. It details the productivity gains and operational cost savings at the ANSP level that can be obtained by unifying air traffic management services in Europe.

This study aimed to establish the order of magnitude of fragmentation’s impact, intended as the costs arising from dividing air navigation services into smaller decision-making or operational units, versus what would result from considering an optimum scale.

The study focuses on gauging cost savings and economies of scale related to a higher degree of integration and centralisation among European ANSPs, considering fragmentation issues around area control centres (ACCs), ATM systems and interfaces, the duplication of CNS infrastructure and associated support costs.

As they date back to 2006, estimates from this study are not directly taken into account in the final evaluation, but are used to illustrate the various operational gains that may result from higher integration into ATM provision.

The fragmentation issues are divided into five categories, as portrayed in Table 5.

Table 5 – Costs of European airspace fragmentation by category

Category	Issues	Annual cost (€m)
Common issues	*Piecemeal procurement (mainly ATM systems)*	30-70
	Sub-optimal scale in maintenance and in-service development (mainly CNS)	10-15
	Fragmented planning (duplicated planning activities)	60-120
	Unsynchronised technological change	Counted elsewhere
ACCs	*Economies of scale in ACCs (operating costs)*	370-460
	Economies of scale in ACCs (capital costs)	104-140
	Constrained sector design (flight efficiency benefits)	50-100
ATM systems	*Lack of common systems (operating costs)*	150-215
	Lack of common systems (capital costs)	30-90
	Increased coordination at interfaces	10-20
CNS Infrastructure	*Optimum location of en route navigation aids*	3-7
	The overprovision of secondary radar	15-60
Associated support	*Economies of scale in training, administrative costs and research and development (R&D)*	40-100
Total		**880-1,400**

Most of the problems identified involve operation inefficiencies (e.g. piecemeal procurement, sub-optimal scale in maintenance) and the sub-optimal deployment of resources (e.g. economies of scale in ACCs, navigation aids and radar) that follow from the sub-optimal scale of ANSP units in Europe. There is substantial evidence for economies of scale (both in capital and operating costs) arising from low utilisation, which will inevitably occur at times of low demand in very small centres and through the sharing of fixed costs over more activity. In addition, the organisation of ANSPs at the state level leads to higher costs of coordination and system incompatibility, as well as unsynchronised planning and investment appraisal.

The study focuses on the cost of existing systems compared to what it would be if there was a higher degree of concentration. **This study's perspective is entirely cost reduction oriented and based on cost function and coverage optimisation.** Hence, matters such as fragmented planning and unsynchronised technological change – except for the duplication of planning activities at national ANSPs and EUROCONTROL – are not assigned a separate cost to avoid double counting, and are not assessed in terms of the incremental benefits they can bring to the system.

Similarly, the cost of constrained sector design (i.e. the location of crossing points away from sector boundaries) is prudentially estimated as a proportion (between 5% and 10%) of the current cost of route trajectory inefficiencies between the actual en-route flight length and the great circle cited by EUROCONTROL (2005)[3]; it equals €1 billion per year.

[3] Performance Review Report 8, Performance Review Commission, April 2005.

European ATM Master Plan (2020)

'Digitalising Europe's aviation infrastructure'

The *European ATM Master Plan 2020* contains the latest benefit report produced within the SJU project and is still awaiting approval from the SJU Administrative Board at the time of writing. Compared to SESAR (2019) and the 2015 ATM Master Plan, the ATM Master Plan 2020 offers a most comprehensive evaluation: it is not limited to direct impacts, but also considers indirect impacts and further passenger benefits.

The expected benefits are quantified in monetary terms and divided into three main categories:

- **Direct impact on the value chain:** The direct impact takes into account cost savings for the industry (i.e. ATM equipment manufacturers, aircraft manufacturers, airlines, ANSPs and airports). Consistent with SESAR (2019) and the 2015 ATM Master Plan, direct effects encompass cost efficiency, leading to lower ANS unit costs per flight, operational efficiency and environmental efficiency generated from increased capacity and other initiatives driven by SESAR implementation.
- **Indirect impact of the value chain**: This includes the total increased activity of those supplying the industry (e.g. airline suppliers). The income and GDP produced by downstream sectors support the activities of the direct value chain.
- **Passenger benefits and other effects on society.** Similar to SEO (2015), this includes passenger benefits that arise from additional connectivity (e.g. flights enabled and time savings because of minimised delays and shorter flights). Other quantified SESAR impacts are lower air pollution and climate change impact per flight (propelled by lower fuel burn).

Figure 3 presents the cumulative expected benefits as reported in the ATM Master Plan 2020. For the purpose of comparability with other documents reviewed, we limit our analysis to 2035. Concerning direct impacts, the total benefits expected from 2012 to 2035 amount to €7.8 billion per

year[4] (€19 billion in 2035). Generally, accounting for the indirect impact on the value chain and passengers, the ATM Master Plan 2020 establishes a cumulative overall benefit of €400 billion (€31 billion in 2035) during the period, which corresponds to nearly €17.4 billion per year.

Figure 3 – SESAR cumulative benefits (undiscounted) until 2035 (Source: Adjusted from the ATM Master Plan 2020)

[4] Lacking detailed information, we guessed this value from the chart (Figure 3). Almost €180 billion in cumulative direct impact in 2035, and €400 billion in cumulative value, result when including indirect effects and the effects on passengers.

Steer (2020)

‘Study on the current level of protection of air passenger rights in the EU’

Steer (2020) reports on the costs of implementing Regulation 261/2004 from 2011 to 2018 in relation to traffic changes and air transport performance. Costs of Regulation 261/2004 raised from €1.6 billion in 2011 to €5.3 billion in 2018, corresponding to a cost per passenger increase from €1.8 in 2011 to €4.4 in 2018. The rationale of this growth is twofold. On the one hand, the number of people claiming compensation rose in relative terms, leading to a claim rate of 38% (8% in 2011). On the other hand, the number of disruptions (both in terms of cancellations and delays) has been expanding over the years, ranging from a minimum of 67,200 cancelled and 60.8 m delayed flights in 2011 to a maximum of 131,700 cancelled and 109.4 m delayed flights in 2018. Part of the increase in these costs is linked to the higher levels of ATFM delays generated under the SES initiative, which are not within airlines’ control. According to the CODA report (EUROCONTROL, 2019), in 2018, the average en route delay per flight equals 1.68 minutes per flight, 1.18 minutes higher than the target value of 0.50. The portion of delays due to ATFM-related causes equals 17.6%. Assuming that the target value of 0.5 minutes per flight was reached, and that this efficiency gain is distributed such that the reduction in the delay per flight corresponds to a proportional reduction in the number of delayed flights, we estimate the potential amount of yearly savings for airlines. This value ranges from €420.4 to €650.8 million, in case the decrease in delays per flight only impacts delay-related costs, or both delay- and cancellation-related costs, respectively (Table 6).

Table 6 – Potential savings related to a reduction in the average delay per flight

Yearly estimate (€m)	2018
Regulation 261/2004 costs	
Compensation	2,258
Care	932
Reimbursement/Re-routing	1,787
Mishandled Baggage	302
Total	**5,279**
Potential savings – target of 0.5 minutes of delay per flight*	70.2%
Portion of costs due to delays*	64.6%
Portion of delays related to ATFM	17.6%
Total savings	**420.4–650.8**

* Estimated values

2.2 Scientific literature and other reports

An important stream of the literature has demonstrated that Europe's fragmented ATM system is characterised by a variety of efficiency levels.

Different studies have shown how airspace fragmentation contributes to inefficiencies in Europe's ATM system. For example, Standfuss et al. (2019) stressed that reduced fragmentation could increase the efficiency of ANSPs thanks to economies of scale. The literature has also focused on cost-efficiency benchmarking of European ANSPs (e.g. Bilotkach et al., 2015; Button and Neiva, 2014; Arnaldo et al., 2014). The evidence demonstrates that European ANSPs are inefficient.

By combining information about ANSPs' efficiency in these studies with that of their overall cost at the European level, we were able to estimate the potential cost savings in terms of full efficiency recovery. For example, using the average ANSP's cost-efficiency (0.519 in 2011) identified by Bilotkach et al. (2015) and the total cost of ANSPs in 2011, revealed in the ATM-Cost effectiveness 2011 report (€8.8 billion) regarding a full efficiency recovery, we were able to quantify potential savings at €4.2 billion.

Considering the quantification of SES benefits, numerous studies have been carried out in recent years, mainly addressing simulation analyses of economic and ecological savings estimation. Compared to policy and consultancy reports, scientific articles have undertaken a narrower view, focusing on specific aspects that shed light on cost savings. They have mostly calculated fuel consumption, emissions, flight time and distance reduction. Simulation analyses have been performed, relying on different methodological settings and contexts (time and geographical areas) and providing punctual estimates that go beyond a general and aggregate estimate (e.g. SESAR projections), while preferring a more analytical approach subject to fewer hires. We review the major contributions in the following paragraphs.

- **Henn et al. (2012)** determine the impact of free routes, comparing network trajectories to free-flight trajectories under the SES initiative, computed using the flight planning software

Lido/Flight (developed by Lufthansa Systems) for a flight sample composed of the most frequented intra-European flight legs in 2007 (representing 24% of flights globally). Network trajectories result from the current structured route configuration. Free-flight trajectories, on the other hand, are established by adding artificial route segments to published airways (the current structure) and using four different optimisation target functions in order to identify the best en route phase trajectory for each flight. The different free-flight trajectories pinpointed using different objective functions are: the minimum distance track (MDT); the minimum time track (MTT); the minimum fuel consumption track (MFT); and finally, the minimum operating cost track (MCT). The authors show that compared to the agreed upon network trajectories, free-flight MFT fuel consumption is on average 3.18% lower. Extrapolating this result to all European 2007 air traffic, the authors quantify 835.4 million kg in potential fuel savings per year. The operating costs of potential savings, verified by comparing free-flight MCT to network routes, is on average 3.23%. Moreover, free-flight trajectories, in the case of flight distance optimisation (MDT), lead to 2.62% and 15.6 NM shorter than respective network trajectories. Finally, free-flight MTT trajectories, in contrast to network ones, on average save 3.2% (corresponding to 3 minutes).

- **Bentrup and Hoffmann (2016)**. Using the same simulation software (Lido/Flight), Bentrup and Hoffmann (2016), determine in a later study the benefits of free routing airspace in Europe using a representative set of flights from Eurostat in 2014. They analyse 10,492 flights (representing 52% of passengers globally, carried within Europe) between the top intra-European city pairs in terms of total passengers. Eleven scenarios are simulated with different airspace parameters (the presence or lack of user-defined trajectory points and different maximum segment lengths) and meteorological conditions. As outlined in this study, for every flight in each scenario, Lido/Flight generates two different trajectories: the MFT and the MCT, each calculated once in airspace with traditional routes, and then in free routing airspace. The MCT, even in this case, minimises the total direct operating cost (aircraft time, fuel expenses and air traffic control [ATC] charges). Simulation outcomes show, by applying

free routes, a high operating cost reduction variable between 1.4% and 3.8% in the different scenarios. Free route application leads to considerable fuel savings, estimated to range between 0.9 % and 4.7% based on the specific scenario.

- **Rosenow and Fricke (2019),** in contrast to previously mentioned studies, use a multi-objective simulation to identify trajectories under free routing conditions. The simulation environment TOolchain for Multi-criteria Aircraft Trajectory Optimization (TOMATO) allows for the optimisation of flight intentions, taking into account both ecological and direct operating costs (mainly driven by fuel and time costs). Emissions are converted into monetary values to quantify ecological costs by using the European Emissions Trading System (ETS) and assuming a price of €65 per ton of CO_2 equivalent emissions. The optimal free routing trajectories are then compared to a reference scenario wherein trajectories are taken from the EUROCONTROL flight plan. The sample analysed is composed of flights to and from European airports, and includes overflights above European airspace operated in July 2016. Under free routing conditions, the simulation results show increased airline and network efficiency (optimised trajectories reduce direct operational costs by around 40%, and increase airspace capacity), as well as fuel savings of about 20%.
- **Nava-Gaxiola et al. (2018)** determine potential savings in an extreme future scenario in which free routes are implemented in the complete upper airspace of the ECAC. FRA benefits are evaluated in terms of route efficiency (measured in terms of distance, time, fuel and reduced emissions), the number of aircraft conflicts and traffic complexity. The authors compare actual trajectories with those that could optimise the flight distance (using NEST software) using a sample of 24,876 flights collected on a summer day (Aeronautical Information Regulation And Control [AIRAC] 1707).

  The comparison outcomes reveal that a full FRA does not increase either the complexity values or the number of aircraft conflicts. Moreover, the total length of the flights in question is lowered by an approximate distance of 2.2%. This reduction leads to 5,274 tons of fuel

reduction, which, when converted to euros (using €65/ton from IATA values), represents a cost decrease of €3.19 million per day.

- **PwC (2016)** analyses the economic impact of ATC strikes in Europe from 2010 to 2015. The study considers four key channels through which flight disruptions affect the economy, namely the impact on airlines' revenues, the loss of passengers' productive time and tourism revenues, and the effect on air cargo. By modelling the consequences using a computable general equilibrium model, the report predicts that the overall impact of ATC strikes might reduce the EU's GDP by €10.4 billion over the next 6 years, leading to a cumulative negative effect in terms of EU employment, equal to 140,000 jobs. Overall, most of the ATC strikes' impact is linked to reduced tourism spending. As far as traffic and operational disruptions are already accounted for in SESAR's capacity KPA estimate, and in HELIOS' evaluation of inefficiencies, we undertake a conservative perspective that does not consider the ATC strikes' influence, in addition to the impacts of SESAR (2019) and SEO (2015), in order to avoid double counting.
- **Ricardo Energy and Environment (2017)** investigate the effect of ATM strikes on ATM's performance in the EU. Along with the fact that the performance objectives of SES can be adversely impacted by disruptive events, the report aims to identify the propagation effects of strikes occurring in specific countries in relation to other regions through cancellations, delays and re-routing. The findings demonstrate that 15 member states (out of 28) were not affected by the strike actions of national air traffic controllers, and that only 7 of the remaining 13 were impacted by strikes lasting longer than two days. Overall, the data show that the strikes caused 9 million minutes of additional delays from January 2014 to December 2016. Relying on standard inputs for EUROCONTROL's cost-benefit analyses, the report underscores the costs of a strike event in four countries (France, Greece, Italy, Spain), which experienced moderately frequent strikes between 2014 and 2016. Accounting for a mitigation in cancellation costs (i.e. passengers still reach their final destination), the outcomes imply that the average cost of a strike is higher in France (€11 million for 41 strikes per year). Due

to its geographic position, strikes in France were responsible for a large proportion of strike days and delays in Europe.

Other studies focus on SES benefits in limited geographic regions. For example, Nava-Gaxiola and Barrado (2016) provide some measures for the expected benefits of introducing the FRA in southwest FAB (Functional Aerospace Block). Starting from a sample of 5 days of flights that took place 2014, and a traffic forecast through to 2019 (considering a traffic increase of 15%), estimates rely on a traffic simulation model's performance measures in terms of flight efficiency and controller task load. The authors determine that the complete implementation of Southwest FAB results in 190 tons of fuel and 57 tons of CO_2 emissions savings per day (corresponding respectively to 69,350 tons of fuel and 20,805 tons of CO_2 per year). Moreover, a saved flight distance of 2.25% has been predicted in actual scenarios; that figure is 2.3% for future scenarios. Implementing free routes will not increase controllers' volume task load or their task load peak.

Other studies reveal potential fuel savings in small regions' airspace, such as six tons per day in the Czech Republic (Kraus, 2011).

Table 7 summarises the features of papers that estimate cost savings due to unifying the entire European airspace.

Table 7 – Literature review related to unifying European airspace

Paper	Investigated impact	Methodology	Geographic area	Reference years	Results
Ansuategi et al. (2019)	Fragmentation impact on ATM efficiency	Stochastic frontier analysis (SFA)	37 European ANSPs	2006-2016	Different FABs are classified according to the different potentials in terms of efficiency recovery derived from the integration.
Arnaldo et al. (2014)	ANSPs' benchmarking	Data envelopment analysis (DEA)	35 European ANSPs	2001-2011	The findings shed light on various ANSPs in Europe regarding their relative efficiency, and imply which strategies and actions each ANSP should undertake in order to reach an optimum level of efficiency. The comparative analysis suggests which ANSPs have a greater margin of efficiency improvement.
Bentrup et al. (2016)	-Overall reduced costs -Potential fuel savings	Simulation with Lido/Flight software according to different target functions: -MFC -MCT	Europe	2014	The results underscore a high cost reduction (from 1.4% to 3.8%) and fuel savings (from 0.9 % to 4.7%) in all scenarios.
Bilotkach et al. (2015)	ANSPs' benchmarking	DEA	37 European ANSPs	2002-2011	ANSPs' overall productivity has increased over the time period covered by the study. At the same time, there are disparities in how various ANSPs perform. This evidence implies an inefficient mix of inputs used by ANSPs. The analysis only centres on efficiency differences given current organisational arrangements, and ignores potential efficiency gains that could be achieved by moving to the SES system.

Button and Neiva (2014)	ANSPs' benchmarking	DEA	36 European ANSPs	2002-2009	The outcomes indicate a wide dispersion in levels of efficiency. Some systems have maintained a high level of relative efficiency, while others have improved their relative positions, but a number consistently tend to fall behind.
Henn et al. (2012)	-Reduced fuel consumption -Reduced flight distances -Reduced flight times -Reduced operating costs	Simulation with Lido/Flight software according to different target functions: -MFC -MDT -MTT -MCT	Europe	2007	- 835.425.671 kg in potential fuel savings - Average trajectory of 15.6 NM or 2.62% shorter - Potential time savings (around 3 minutes per flight) - Reduced operating costs (by around 3.2%)
Kraus, 2011	Potential fuel and emissions savings.	Estimation from FRA application during night.	Czech Republic	2011	Potential savings of around 6 tons of fuel or 18 tons of CO_2 per day.
Nava-Gaxiola et al. (2018)	Evaluation of potential benefits in terms of flight efficiency, aircraft conflicts and airspace complexity of free route implementation in the complete upper airspace of ECAC.	Simulation with the Network Strategy Tool (NEST), which optimises flights distances.	Europe	2017	- Reduced route distances with potential benefits (around 2.2%) - 5,274 tons of fuel, converted to euros, represents a cost reduction of €3.19 million per day - No increase, either in the complexity values or in the number of aircraft conflicts
Nava-Gaxiola and Barrado (2016)	- Potential fuel, emissions and flight distance savings - Impact on controllers' task load	Traffic simulation model	Southwest FAB (Spanish, Portuguese and Canarian airspace)	2014 and 2019 forecast	- Potential savings in Southwest FAB of 69,350 tons of fuel and 20,805 tons of CO_2 per year - Reduced flight distances (around 2.2 %)

					- No increase in controllers' task load
Rosenow and Fricke (2019)	Reduced fuel consumption and fewer direct operational costs for airlines	Simulation with TOMATO	Europe	2016	- Reduced fuel consumption (around 20%) - Reduced operational costs (around 40%) - Increased airspace capacity
Standfuss et al. (2019)	Fragmentation impact on ATM efficiency	DEA	37 European ANSPs	2016	Reduced fragmentation could increase the efficiency of ANSPs due to economies of scale. However, although in general, the union of ANSPs increases efficiency, in some cases, their integration is not the optimal solution given the occurrence of diseconomies of scale.

2.3 Discussion

Several studies have addressed the costs related to the fragmentation of European airspace, undertaking different perspectives. This section discusses the analysed policy and consultancy reports, as well as the scientific articles, across a set of dimensions that allow us to cover all aspects linked to SES benefits.

- **Capacity**
  - Reduced delays
  - Reduced unaccommodated demand
- **Trajectories**
  - Reduced fuel consumption
  - Reduced emissions
  - Reduced travel time/flight distance
- **ANSP productivity**:
  - Optimal deployment of resources
  - Economies of scale
  - Adoption of synchronised technology

Capacity

Today, with more flights occupying Europe's airspace, current ATM operations and procedures are stretched to their limits, putting airspace capacity under pressure. The lack of a seamless airspace re-organisation will cause a shortage of capacity over time, leading to growing delays. Joint monitoring of trajectories and collaborative decision-making among stakeholders, greater flexibility in operations management, and timely network management help to mitigate flight delays (both departure and arrival).

The impact of reducing delays plays a major role in assessing the cost of non-Europe (e.g. SESAR, 2013; SESAR, 2015; SESAR, 2019; SEO, 2015, Steer, 2020).

The SJU's 2019 proposal provides detailed figures for the period of 2019 to 2035, considering the potential of accommodating up to 15.7 million flights, along with the full implementation of the

transition strategy. Estimates have been handled by measuring reduced delays, as predicted in the Master Plan, and accounting for reduced delays caused by staffing, disruptions[5], planned events and weather, for an overall impact of €34 billion (see the SESAR form in Section 2.1). However, this estimate is addressed by taking into account a conservative scenario (Master Plan ambitions), involving a delay reduction of 4 minutes per flight through to 2035. When considering Network Manager EUROCONTROL forecasts (a reduction of 8 minutes through to 2035), the calculated capacity benefits increase substantially by +88%. In addition, Steer (2020) points out an increase in reimbursement costs, from €1.6 billion in 2011 to €5.3 billion in 2018, of which about €0.42 to €0.65 billion can be saved if the ATM target is met.

The SEO (2015) study quantifies the impact of delays, relying on the assumptions of the SESAR Master Plan's (2015) assessment, and regarding two different kinds of impact: (1) the effect on airlines' operating costs and (2) the effect on passengers in terms of lower travel times and higher reliability. Moreover, the SEO study explicitly accounts for the increase in capacity, leading to higher connectivity levels and reduced unaccommodated demand.

Flight trajectories

As pointed out by SESAR (2019), the lack of a seamless European airspace (i.e. the provision of air navigation services based on small geographic areas managed at the state level, and the limited coordination of operational decision-making within these regions) causes inefficiencies in Europe's current aviation system. Mitigating flight profile inefficiencies represents a major benefit in the SES

[5] Strikes comprise an important cause of extended delays. According to PwC (2016), the overall impact of ATC strikes could be up to €1.73 billion per year.

assessment in the sense that deviations from the optimum trajectory produce additional flight time, burn more fuel and generate higher costs for airspace users.

Departing from the SESAR Master Plan 2015, wherein indirect economic benefits are directly tied to enhanced flight efficiency due to reduced flight times, extra fuel burned and CO_2 emissions, SESAR (2019) aims to predict the indirect impact of improved network efficiency, largely focusing on the environment. The reduction in nautical miles that results from the increased efficiency of fully implementing SESAR's transition strategy is expected to generate an overall benefit of €3 to €6 million from 2019 to 2035. This is associated with lower fuel consumption for all forecasted traffic (€2.6 to €5.8 billion) and the fuel efficiency gains related to deploying 4D trajectories (€22 million). In line with SESAR's Pilot Common Project (2013), fuel efficiency benefits lower CO_2 emissions and are monetised in terms of EU emissions allowances[6].

On top of these impacts, which are promptly monetised in light of the SESAR Master Plan (2015) and European Commission studies (Ricardo-AEA, 2014), SEO (2015) examines further welfare implications for reduced travel times based on more direct flight profiles; this saves time and usually leads to a lower generalised cost of travel for passengers.

Helios (2006) provides an estimation for the impact of constrained sector design (See Section 2.1). As stated in the report, the value was assessed by relying on interviews with experts in the field, acknowledging that this an area in which further analysis would be worthwhile to provide a more robust estimate.

ANSP productivity:

A major benefit of unifying ATM at the European level would follow from improved ANSP cost efficiency and productivity. Indeed, ANSPs' services are highly fragmented into state or sub-state

[6] Credits allocated to companies (1 credit represents the right to emit 1 ton of CO_2).

units, which are characterised by various efficiency levels regarding the provision of air navigation services in Europe (see Section 2.2 – Scientific literature). The following chart, taken from the '*ATM cost-effectiveness (ACE) 2017 benchmarking report with 2018-2022 outlook*', shows how most European ANSPs are inefficient (Figure 4), thus highlighting the significant potential cost savings in terms of full or partial efficiency recovery.

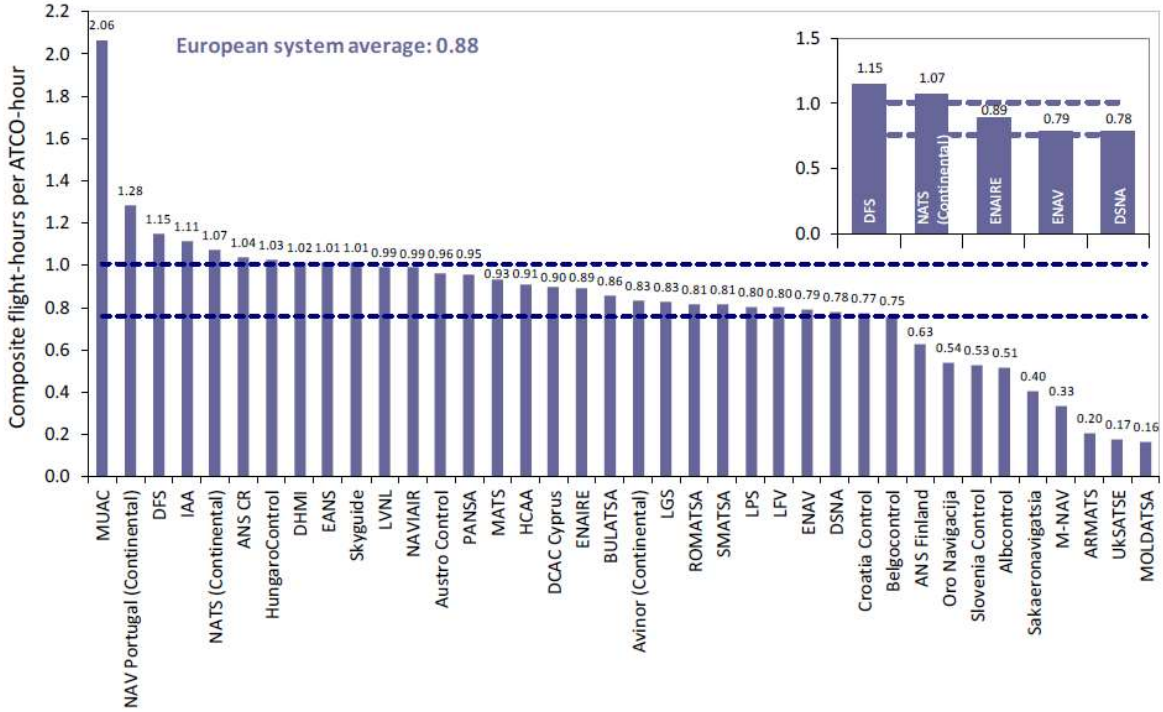

Figure 4 – Air traffic controller (ATCO)-hour productivity (gate-to-gate), 2017

Based on the classification proposed by Helios (2006), cost savings at the ANSP level can be achieved through a higher degree of integration for leveraging economies of scale, the optimal deployment of resources and pursuing the adoption of synchronised technology (see Section 2.1).

Helios finds that sub-optimal ACC size is a main factor of Europe's ATM fragmentation cost (53% of inefficiency). Other major drivers of fragmentation costs include the loss in flight efficiency, as airspace and route design are organised in a fragmented way (14% of inefficiency), and a lack of common systems (23% of inefficiency). Regarding the benefits that may result from adopting

synchronised technology, they are not typically assigned separate costs in order to avoid double counting and are implicitly accounted for in other components. The quantification provided by Helios (2006) gives a total estimated benefit of around €880 to €1,400 million per year, based on the as-is scenario and current volumes as of 2004. Although dating back to 2004, the valuation provided by Helios (2006) mostly relies on the current ANSP infrastructures and is not sensitive to traffic volume, therefore making it a prudential, lower bound estimate for years ahead. Neither SESAR (2019) nor SESAR (2015) clarify in as much detail as Helios which aspects have been considered. The same goes for SEO (2015), which relies on SESAR estimates for cost savings (due to ANS and ANSP higher productivity), and assumes that they can be passed on to airlines in the form of lower route charges, and eventually to passengers via lower airfares. However, the SESAR estimation (€5 to €7 billion from 2019 to 2035) is much lower than that of Helios, suggesting that not all effects pointed out by Helios were fully considered in the analysis. On the other hand, a much higher evaluation is provided by IATA (2013a), which predicts a potential cost reduction per annum, related to air navigation services' provision, of 50% (i.e. €4 billion) in 2020.

2.4 Conclusion

Due to the different ways of monetising airspace unification, '*foggy*' assumptions, distinct time horizons and unique perspectives considered in the above-mentioned studies (e.g. welfare-oriented, cost-oriented), the combination of estimates into a comprehensive approximation, which sums up values from different reports, should be conducted carefully. Following this approach, Table 8 provides a synthetic estimation for SES. Undiscounted values have been equally normalised on a yearly basis. As previously discussed, SESAR estimates (the 2019 and 2020 reports) are taken as the most reliable and updated reference to predict cost savings in terms of capacity and the environment. To these values, we add the welfare contribution for time savings, connectivity and capacity as determined in SEO (2015), taking into account the negative environmental contribution due to societal costs. Economies of scale and inefficiencies in ANSP productivity (due to fragmentation) come from Helios' (2006) estimates.

On top of the benefits associated with unifying European airspace in intra EU-transport, in the sense of seamless operations, an integrated and single aviation market could generate potential benefits for intercontinental air traffic. The European Parliament (2014) reckons that such an effect could range from €0.9 billion to €1.8 billion, including savings due to a more balanced geographic distribution of intercontinental air gateways and more efficient transport service (e.g. lower operational costs of carriers, reduced travel times and lower fares for passengers).

Overall, the estimated benefits of a seamless European airspace most likely range from €4.05 to €7.43 billion per year in the lower-bound scenario, and from €8.97 to €12.35 billion per year in the upper-bound scenario. The reasonability of these forecasts is confirmed in light of the most recent ATM Master Plan 2020 estimates – which comprehensively account for direct, indirect and passenger-related benefits **– resulting in higher values ranging from €7.8 (the industry effect) to €17 billion (the social effect)**.

While these estimates demonstrate that a seamless European airspace could bring significant benefits, the evaluation of wider impacts might offer important insights, although not easily quantifiable. For instance, at first glance, implementing ATM improvements provides benefits in terms of dealing with both aircraft noise pollution and managing ATC strikes due to increased coordination and efficiency. At the same time, such an action might cause problems (e.g. more air traffic and uncontrolled propagation) inside a more integrated aviation network.

Table 8 – Total estimation of SES

	European airspace and applying SES		Yearly impact on the industry (€bn)		Yearly overall impact (Industry + Socio-economic impact) (€bn)		
Main reference	**Dimension**	**Period**	**Lower range**	**Upper range**	**Lower range**	**Upper range**	**Notes**
SESAR (2019)	Capacity	2019-2035	2.13	3.94	2.13	3.94	
SESAR (2019)	Environment	2019-2035	0.19	0.38	0.19	0.38	
SESAR (2019)	Cost efficiency	2019-2035	-	-	-	-	ANS cost efficiency
SEO (2015)	Impact on travellers	2015-2035			5.57	5.57	Net cost savings (accounted for in SESAR and HELIOS)
SEO (2015)	The environment	2015-2035			-1	-1	
SEO (2015)	Wider economic impact	2015-2035			0.35	0.35	
HELIOS (2006)	ANS cost efficiency	2006	0.83	1.30	0.83	1.30	Net flight trajectory inefficiency (accounted for in SESAR)
European Parliamentary Research (2014)	Intercontinental traffic re-balancing	2014	0.91	1.82	0.91	1.82	
Steer (2020)	Air passenger rights	2018	0.42*	0.65*	0.42*	0.65*	Estimated gains thanks to improved ATFM efficiency
Overall			**4.48**	**8.09**	**9.40**	**13.01**	
ATM Master Plan (2020)				**7.80**		**17.40**	

** It is not clear whether this expense is already included in the estimates of costs related to modernising SES by SESAR (2019) and SEO (2015).*

3 Airport charges and regulatory processes

The debate on the need for, and intensity of, regulating airport charges is broad and unresolved: in particular, it is not clear which is the right way to manage airports and with what degree of strength. Principles from the International Civil Aviation Organization (ICAO) should be followed: charges should be cost-related (i.e. airlines only pay for the facilities they use), transparent, non-discriminatory and subject to consultation. In practise, if airports retain some degree of market power, they have an incentive to set a higher level of airport charges. Such charges account for more than half of airports' revenue (55 % in 2014, according to ACI-Europe '*2015 ACI Airport Economics Report*').

The topic is relevant due to the possible effect on airline markets and because of the absolute airport charge incidence. IATA's 'Aviation charges, fees and taxes' fact sheet (2019) reports how airlines and passengers are estimated to have paid around $141.8 billion in 2018 for the use of airports and air navigation infrastructure globally.

Within this framework, the EU directive on airport charges, adopted in 2009 by the European Parliament and the Council of the EU, aimed to harmonise airport charges procedures. The directive established a process-oriented framework (involving consultation and transparency), leaving the possibility to member states to adopt their own regulations.

In this section, we evaluate the impact of non-Europe on airport charges, and more specifically the way in which the current directive has been interpreted and applied, by identifying the benefit of a better, more homogeneous transposition of the directive. We also address the need to review it.

First, we briefly describe EU Directive 2009/12 concerning airport charges. Subsequently, we examine its effects, and pinpoint possible improvements by looking at different reports and studies.

The EU's Airport Charges Directive (ACD)

Airport charges are levied on airport users for the use of airport facilities and involve the landing, take-off and parking of aircraft, as well as the processing of passengers and freight.

Before the ACD was introduced, the regulatory framework for airport charges was defined at national level, resulting in distinct frameworks among the EU's members states. Furthermore, in some states, the system of airport charges was governed without an adequate information flow between stakeholders (airlines, passengers, etc.). Consequently, airport users were not systematically consulted in all EU airports during the process of determining airport charges.

In 2009, the EU Council and European Parliament adopted the ACD, seeking to create a common framework for fixing airport charges in a more transparent way. Member states transposed it into national legislation between 2011 and 2014. The ACD covers the charging systems of airports with more than 5 million passengers per year, and at a minimum the largest airport in each member state.

Moreover, the ACD regulates only a fraction of the overall charges commonly levied by airports. The ACD focuses on passenger, runway and parking, infrastructure, cargo and noise charges. By contrast, the directive does not include charges related to en route and terminal air navigation services, passenger security, ground handling or passengers with reduced mobility.

The ACD did not impose a formal price regulation for airport charges; however, it introduced core principles to be followed when fixing charges in order to create a common European framework.

Key tenets established by the ACD are:

- Non-discrimination between airport users
- A common, transparent charging system across airport networks and among airports serving the same city
- Regular consultation of airport users by airport managers (at least once a year)

- The establishment of national independent supervisory authorities (ISAs) to ensure that the ACD's measures are applied correctly.
- The right to seek an intervention from the member state's ISA in case of a dispute between airports and airlines over airport charges
- Transparency by the airport manager regarding the cost basis for setting charges
- Consultation of airport users on plans for new infrastructure
- Flexibility to allow airport managers to offer differentiated services to airlines

The ACD's implementation was not uniform across member states for various reasons. On the one hand, some member states' legislation (e.g. the UK, the Netherlands) already included some ACD provisions before it was transposed, as reported by Steer Davies Gleave (2013). On the other hand, not all member states fully complied with the ACD's requirements after the transposition deadline. Following the ACD transposition deadline, the Commission delivered formal notices to some member states to begin infringement proceedings for failure to comply with the directive. Member states subject to formal notice included Belgium, Finland, Greece, Hungary, Italy, Poland, Spain and Sweden. After the transposition deadline, the Commission launched investigations (via the EU pilot mechanism or formal infringement procedures) against 13 member states. These were either triggered by complaints from airlines, airline associations, citizens, or the Commission's own initiative. The primary concerns relate to the consultation process and the transparency of information linked to it, discriminatory charging systems and the independence and responsibilities of the national ISAs.

Regarding the ACD's effect, note that few studies have focused on quantifying the benefits of implementing it over time.

3.1 Main documents analysed

- '*The Airport Charges Directive and the level of airport charges*', *JRC Technical Report (2018)*

- '*Did the EU Airport Charges Directive lead to lower aeronautical charges? Empirical evidence from a diff-in-diff research design', Conti et al. (2019)*
- '*Evaluation of Directive 2009/12/EC on airport charges*', *Steer Davies Gleave (2013)*
- '*Support study to the ex-post evaluation of Directive 2009/12/EC on airport charges', Steer Davies Gleave (2017)*
- '*Evaluation of the Directive 2009/12/EC of the European Parliament and of the Council of 11 March 2009 on airport charges', European Commission (2019)*
- '*Economic benefits from effective regulation of European airports', IATA (2017)*
- '*Airport competition: Myth or reality?', IATA (2017)*

JRC (2018)

'The Airport Charges Directive and the level of airport charges'

The technical report '*The Airport Charges Directive and the level of airport charges*' was commissioned by the Joint Research Centre (JRC), the European Commission's science and knowledge service, which provides evidence-based, scientific support to the European policymaking process in order to assess whether the ACD's introduction had a significant effect on the level of airport charges.

The report compares the evolution of airport charges in airports covered by the directive (over 5 million passengers) and that of a control group (airports with traffic between 2 and 5 million passengers) to determine the directive's impact. In the first part of the study, only airports with less than 20 million passengers covered by the ACD were included in order to not distort the outcomes by comparing airports with excessively different dimensions. Large airports differ substantially from smaller ones both in terms of market power and economies of scale, in addition to the presence of long-haul, intercontinental flights.

The ACD's influence on very large airports is quantified by comparing them with Asian and American airports that serve a similar number of passengers.

Because airport charges vary according to several factors such as the number of passengers, aircraft size, parking time and types of services used at the airport, the study considered four scenarios, wherein the relevant charges are computed.

The four scenarios refer to:

- An intra-European short-haul flight operated by a full-service airline
- An intercontinental flight operated by a full-service airline
- An intra-European short-haul flight operated by a low-cost company
- A regional flight operated by a regional carrier

Study results

The findings can be summarised as follows (Table 9):

- The trend of airports covered by the ACD compared to the same trend of a control group (smaller airports not covered by the ACD) became statistically different only three or more years after the ACD was incorporated into member states' legislation, and only for intra-European scenarios (scenarios 1 and 3).

- The statistical difference between the two trends, triggered by introducing the ACD, is for intra-European full-service carriers (around 10%). This outcome does not mean that charges went down 10%, but rather that without the ACD, the expected trend would lead to 10% higher charges. Similarly, the ACD's effect on airport charges for intra-European, low-cost carriers is about 10.7%.

- For full-service intercontinental and regional flights, no statistically significant effects related to introducing the ACD have been identified

- The ACD does not seem to have affected charges for the largest airports (more than 20 million passengers per year). It is difficult to provide a unique explanation, and the report does not offer a conclusive comment. On the one hand, the result might reflect the fact that the control group of non-EU airports (Asian and American airports) is probably too heterogeneous to be compared with respect to the EU sample in terms of institutions, legislation and economic regulations. On the other hand, it is unlikely that lack of statistical evidences is only due to difficulties in retrieving appropriate benchmarks. Several findings suggest that where airlines' countervailing power is low and economic regulation is weak, airport charges tend to remain high. For those airports, rather than a better transposition of the current ACD, there is a need to review it.

- In analysing charges which are outside the ACD's scope, no statistically significant effects were found for any scenario.

Table 9 – JRC results for different scenarios

Scenario	Results	The relative reduction of in-scope charges between the case and control groups* (per-flight)
1. Intra-European full-service carrier flight	Statistically significant reduction of in-scope charges after three or more years following the ACD's transposition into member states' legislation	€260 (-10%)
2. Intercontinental full-service carrier flight	No ACD impact	
3. Intra-European low-cost carrier flight	Statistically significant reduction of in-scope charges after three or more years following the ACD's transposition into member states' legislation	€330 (-10.7%)
4. Regional flight	No ACD impact	

** The case group is composed of airports that serve between 5 and 20 million passengers annually; the control group is comprised of airports that serve between 3 and 5 million passengers annually (not covered by the ACD)*

Given that the mean value of the in-scope charges of 2016 equals €2,600 for scenario 1 and €3,300 for scenario 3, reductions in airport charges induced by the directive are quantifiable as €260 and €330 per flight, respectively for the two scenarios.

In sum, the report implies that the directive went in the right direction, but also confirms that there is room for improvement, especially for large airports, which accounted for 57.2% of European traffic in 2018, and for which the ACD did not appear to have a significant effect on the level of charges. Hence, there may be a need for further regulatory action.

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Conti et al. (2019)

'Did the EU Airport Charges Directive lead to lower aeronautical charges? Empirical evidence from a diff-in-diff research design'

The paper '*Did the EU Airport Charges Directive lead to lower aeronautical charges? Empirical evidence from a diff-in-diff research design*' published in "Economics Transportation" and stemming from the results of the JRC's technical report, examines whether and how the quality of the ACD's transposition into member states' legislation influences the ACD's effects.

Similar to the JRC's report, this study only considers airports that, between 2008 and 2017, registered at least one year's traffic of over 5 and under 20 million passengers (to increase the degree of comparability). Airports with traffic between 2 and 5 million passengers are scrutinised in order to highlight the evolution of airport charges in airports not covered by the ACD.

Table 10 – Description of two turnaround scenarios

Scenario	Scenario 1	Scenario 2
Flight type	Short-haul Intra-European flight	Short-haul Intra-European flight
Carrier	Full-service carrier	Low-cost carrier
Aircraft	Airbus A320	Boeing 737-800
Capacity	162 passengers	189 passengers
Load factor	81%	90%
Transfer passengers	26 passengers	0 passengers
Arrival time	7.30 AM	10:00 AM
Parking time	45 min	25 min

In this case, given the heterogeneity of airport charges related to the different types of services required, two different scenarios (Table 10) were investigated. The first scenario includes airport charges linked to short-haul intra-European flights carried out by a full-service carrier.

Study results

The findings indicate that the ACD had different impacts depending on the number of years since it was transposed into national legislation. On average, one additional year of the directive being in place reduces airport charges by 2%.

The same analysis was replicated using the out-of-scope charges (not included in the ACD) as the dependent variable, and did not produce any statistically significant result.

In trying to outline whether and how the quality of the ACD's transposition into member states' legislation impacts the ACD's effects, the study used the EU's formal notices to member states as a proxy for the quality of the ACD's transposition into member states' legislation. The outcomes pointed out how the **relative variation in airport charges in the case group, compared to the control group, only occurs in member states that did not receive a formal notice from the EU Commission**, confirming that the effect **was indeed stimulated by the ACD.**

The potential reduction in airport charges – assuming that the member states that received formal notices from the EU to implement the ACD as intended – are estimated to range from 14% to 17%, according to the number of years after the ACD was transposed into member states' legislation (Table 11).

Table 11 – Percentage variation in airport charges in states that received (or did not receive) an EU notice, and potential benefits in states that received an EU notice, according to the number of years of implementation

Years of implementation	The relative trend* of airport charges in countries without EU notice	The relative trend* of airport charges in countries with EU notice	Potential benefits in countries with EU notice
1	- 9.11%	7.94%	- 17.05%
2	- 10.27%	6.28%	- 16.55%
3	- 11.43%	4.61%	- 16.04%
4	- 12.59%	2.94%	- 15.53%
5	- 13.75%	1.27%	- 15.03%
6	- 14.91%	- 0.39%	- 14.52%
7	- 16.08%	- 2.06%	- 14.02%

** The relative trend of the case group (for airports that serve between 5 and 20 million passengers) compared to the control group (for airports that serve between 2 and 5 million passengers)*

For example, if a country with inadequate transposition of the ACD (that received a formal notice) conforms with nations that have better transposition, implementation benefits are quantifiable at 17%.

Steer Davies Gleave (2013)

‘Evaluation of Directive 2009/12/EC on airport charges’

In 2013, the mid-term evaluation of this study was assigned to Steer Davies Gleave in order to judge progress made in applying the ACD and, where appropriate, to make proposals to revise it. This study was conducted less than two years after the ACD was supposed to be transposed. Regarding the effect on airport charges, this study is less relevant than more recent research that are more updated (mentioned above), but its usefulness is linked to an understanding of the chief issues that emerged right after the ACD was transposed.

Some aspects revealed by the mid-term evaluation include:

- The ACD’s central achievements have thus far included an enhanced consultation processes, and, on average, greater transparency of information. However, other impacts of the ACD’s transposition have been limited;
- The ACD has had little impact on the structure and level of airport charges, although stakeholders welcomed clarification regarding the non-discrimination of charges between users;
- Two years after the deadline for transposing the ACD into national legislation, significant issues and gaps remained at the member state level, especially in nations constituting some of the largest aviation markets in the EU (Italy and Spain);
- Competition across European airports, particularly as a consequence of economic conditions, has shifted substantially since the ACD was adopted. Ideally, the ACD should take competitive pressures into account in order to determine which airports should be subject to economic regulations, rather than the current limit of 5 million passengers per year and the largest airport in each member state. The ACD does not address the matter of airports’ market power. Further, it does not constitute any form of formal economic regulation but is rather set up to provide principles and procedures.

The report also made some recommendations to boost the benefits of the Airport Charges Directive, such as:

- All airlines and their representatives should be invited to attend stakeholder consultations;
- In order to enhance transparency so that users can understand the basis for charges, there should be an increased level of granularity in the information provided;
- The concept of network charging systems is inconsistent with the idea that airport charges should be cost-related. Airports that serve more than 5 million passengers should be separated (i.e. ring-fenced) from smaller ones, while charges and proven cost-relatedness should be site-specific;
- It should be possible to appeal ISAs' decisions in all member states to an authority or a court, effectively independent of the ISA and the government;
- ISAs should be more proactive in ensuring that all parties fulfil their consultation requirements to provide information and adequate time for consultation responses;
- There have been some significant gaps or delays in the ACD's transposition in some member states.

Steer Davies Gleave (2017)

‘Support study to the ex-post evaluation of Directive 2009/12/EC on airport charges’

Some of the considerations and recommendations already presented in the 2013 report are also mentioned in the ex-post evaluation of the ACD, commissioned by the EU Commission to Steer Davies Gleave in 2017.

The ex-post evaluation stated that the **ACD has not met all of its objectives and has therefore not delivered all of its benefits**. Such benefits could have been greater than they are, and the costs probably lower or equal, if the ACD had been better transposed into member states’ legislation. Furthermore, in terms of content, the current ACD does not deal with assessing airports’ market power, does not specify how consultation should be carried out, does not indicate the kind of transparency and/or level of information airports should provide, nor does it detail the powers that ISAs should have.

Recommendations provided in the ACD ex-post evaluation include:

- Better national implementation by defining the principles[7] to be followed by member states;
- More focused regulation on airports with the highest levels of market power. This could mean introducing an additional tier of oversight for such airports, identified by assessing market power;
- Improved consultation outcomes by providing binding Commission guidance;
- To work effectively, **the ACD requires that ISAs be skilled, staffed and independent from their state.**

[7] As stated on page 294 of the reviewed report: ‘Minimum principles should be established for national frameworks to follow. These principles might include properly consulting with airports and users regarding the type of economic regulation they decide to implement. The principles cannot be bypassed through law or commercial agreements (e.g. concessions). The economic regulation chosen is not set without a revision date in the foreseeable future, and the ISA is the only party in charge of airport charges’.

- Not all ISAs have been adequately empowered or effectively set up. Some ISAs (Sweden, most German ISAs) are only able to verify that the process of consultation has been followed, and do not have the power to intervene beyond this.
- Clarification that for airport networks, there should be data and cost transparency on an airport by airport basis.
- Better access to appeals by clarifying the roles and responsibilities of all parties.
- Form of legislation: Some of the problems encountered through implementation could be handled by introducing a regulation that would clarify ambiguous provisions, leave less room for inconsistent application among member states, and harmonise the setting of charges across the EU (which is not the case at present).

The ACD ex-post evaluation underscores that the average increase in airport charges, in four different turnaround scenarios between 2009 and 2016, is 23.3%. For 34 airports covered by the ACD, the rise in charges has been greater than this average. At some of these airports (i.e. Rome, Madrid, Barcelona), the charge increase exceeded 80% and was registered by comparing the figures from 2009 and 2016 (using 4 different scenarios),

In addition, focusing on 37 European airport operators covered by the ACD, the report states that in 2014, the EBITDA[8] margin of 9 of them was above the worldwide average (provided by ICAO[9]) and equal to 47.0% in 2014. In 2015, these 9 operators served more than a third (35.3%) of passengers covered by the ACD.

Both the average increase in airport charges and the EBITDA may indicate the misuse of market power by airports.

[8] EBITDA: earnings before interest, taxes, depreciation and amortisation

[9] 'State of airport economics', an ICAO (2016) report produced in cooperation with Airport Council International (ACI).

According to the report, airports with constrained capacity (such as London Heathrow) could present a greater risk of market power misuse. At such airports, since there is more demand than available capacity, airport operators could more easily misuse their market power through underinvestment, poor service quality or excessive charges (where these areas are not regulated), but not experience a reduction in demand sufficient to affect operations.

The EBITDA margin constitutes a partial, indirect proxy of airports' market power; for example, it accounts for airports' revenue from both aeronautical and non-aeronautical activities at an aggregate level. Therefore, it is difficult to ascertain whether airports possess – or misuse – market power, without undertaking a formal market power test.

European Commission (2019a)

‘Evaluation of the Directive 2009/12/EC of the European Parliament and of the Council of 11 March 2009 on airport charges’

The findings of ‘*Evaluation of the Directive 2009/12/EC of the European Parliament and of the Council of 11 March 2009 on airport charges*’, an EU Commission staff working document (2019), are in line with the previous assessment of the ACD (the mid-term and ex-post evaluations).

The overall conclusion is that the ACD has enhanced the setting of airport charges compared to the hypothetical situation in which it were not in place, although the Directive has not fully met its original goals. The ACD is still relevant as the issues underpinning it remain broadly appropriate.

The assessment found that leaving it up to member states to decide on detailed requirements regarding ISAs’ independence, powers and duties (especially in relation to how the ACD’s criteria apply whereby member states determine aspects of airport charges) has been a crucial factor in correctly applying the ACD.

Since the ACD does not presently specify ISAs’ roles or contain any provisions directly focusing on tackling airports’ market power, ISAs are critical in ensuring that charges are being established properly and addressing the risk of airports being able to extract prices that would not be achieved in a competitive market. In some cases, this has led to a partial lack of harmonisation, as national authorities do not have the necessary resources or power to intervene.

ISAs’ inhomogeneous level of power could result in excessive charges because in some member states, there may be no effective regulations. Further, it could weaken the ACD’s effectiveness and lead to different hidden costs for airlines, and more generally for all stakeholders involved in the regulation process.

Moreover, the evaluation outlined how the double threshold, used to define which airports are subject to the ACD’s application, is a very crude proxy for identifying airports with significant market power, but represents an easily applicable criterion.

IATA (2017)

‘Lower airport charges benefits: Economic benefits from effective regulation of European airports’

IATA produced an economic briefing that quantifies benefits from the period of **2006 to 2016, and explores what may have happened if airport passenger charges had remained at their 2006 levels instead of increasing**. IATA’s modelling suggests that, if airport charges had remained stable, then 50 million passengers in the EU would have begun to fly. Moreover, European passengers would save around €11 billion. Lower airport charges would boost the European economy (see Figure 5), resulting in an additional €50 billion in GDP and 238,000 more jobs (considering both the aviation sector and the wider economy, including tourism).

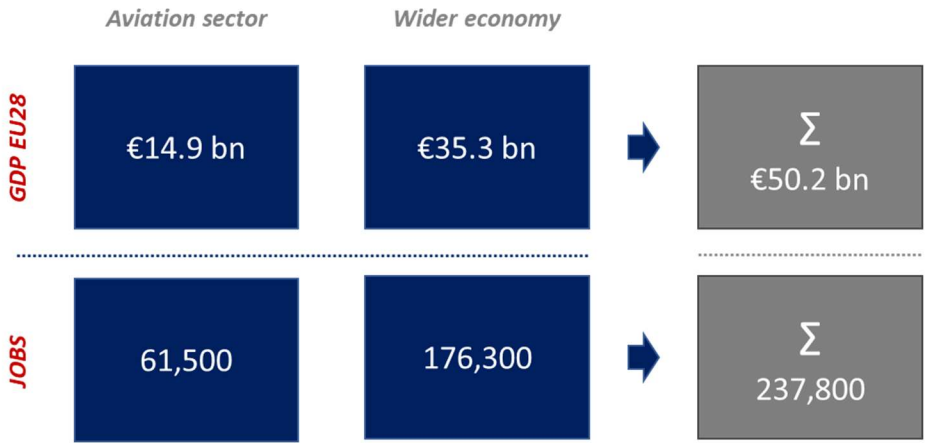


Figure 5 – Benefits from 2006 to 2016 if airport passenger charges had remained at their 2006 levels instead of increasing

IATA (2017)

‘Airport competition: Myth or reality’?

The 2017 IATA report ‘Airport competition: Myth or reality?’ analyses the level of competition between airports and advocates a 3-tier regulation approach involving airports with significant market power.

The study reveals how, between 2006 and 2016, although the average all-in cost of an air ticket bought from an EU28 airport increased by just 2%, both airport passenger charges and taxes more than doubled, with average charges rising from €16 to €33, and average taxes from €6 to €14. Over the same period, average airline revenue per passenger shrank from 90% to less than 80% of the all-in ticket price. This trend may indicate the misuse of market power in some airports.

The study highlights a **lack of competition among neighbouring airports**, suggesting that regulators and policymakers should be careful not to rely on airline competition, which masks the lack of effective competition between airports, as well as the absence of strong commercial imperatives on airport operators to deliver a good outcome for consumers and other airport users (in terms of price and service quality).

Scientific literature and other reports

In some cases, primary evidence regarding the impact of airlines' countervailing power on airport charges has demonstrated opposing outcomes:

- Haskel et al. (2013) shows that if an airline has strong countervailing power, this could lead to lower aeronautical charges. However, they are not usually passed on to consumers through lower airlines fares; different results come from US experiences: Van Dender (2007) and Choo (2014) do not find any statistically significant correlation between the levels of airport charges and carriers' countervailing power in a sample of large US airports.
- Bel and Fageda (2010) discover a negative, robust correlation between airlines' countervailing power (measured by an airport's Hirschman-Herfindal index of concentration based on the number of flights) and the level of airport charges for 100 airports observed in 2007, located in the EU and the European Economic Area (EEA). These findings are confirmed for a panel of the largest 25 British airports observed from 1996 to 2008 by Bottasso et al. (2017).
- Reynolds et al. (2018) assert that 'it is necessary to standardise the mechanism for defining airport charges in different EU member states'. In the same study, Reynolds et al. propose that in order to regulate airports with significant market power, an ex-ante price cap should be determined on a single till basis and by referring to estimated efficient costs.

3.2 Discussion

A variation in the level of airport charges, which are ultimately paid by passengers indirectly via ticket prices, has a significant impact on repressing or stimulating air transport demand and relevant macro-economic effects. The indirect effects of charges are not only felt through ticket prices:

- In the short term, ticket prices are market-driven, so airlines must absorb a substantial portion of the increased costs of higher airport charges (even considering tickets sold 6 to 9 months in advance). Moreover, airlines face significant exit barriers (EC261 liabilities, lost sales, network implications, etc.), so unless increased airport charges exceed exit costs, airlines bear them. Thus, some routes will become unprofitable.
- In the medium term, airlines react on routes that become unprofitable by reducing the supply of seats to these routes, and/or by increasing ticket prices in affected passenger markets. Passengers pay the costs of increased airport charges through higher ticket prices and fewer choices (e.g. available flights are less frequent).
- In the long term, because some passenger markets are subject to reduced seat capacity, airlines encounter a less attractive investment situation for aircraft. Returns come later and are weaker, so capital markets face less than ideal investment circumstances for airlines.

In sum, increased airport charges:

- lead directly to a short-term reduction in route profitability.
- result in a reduced supply of seats on routes affected by lower profitability, with associated localised increases in ticket prices, in the midterm.
- weaken attractiveness for investors in the long term.

Hence, it is crucial to ensure an appropriate, common airport charge system for the airline industry.

The 2009 Airport Charges Directive represented a clear step forward in terms of increasing transparency in the process of defining and updating airport charges. Principles such as non-

discrimination between airport users, the creation of a consultation process and the setup of national ISAs provided on average more clarity in setting airport charges.

In order to measure the ACD's impact on airport charges, some studies have investigated the different trends between airports subject to the ACD, compared to the trends observed in control groups (airports that serve less than 5 million passengers, or based on international benchmarks). The findings of the JRC (2018) imply a statistical difference (quantifiable at around 10%) observed three or more years after the ACD was transposed into member states' legislation. Given the mean value of the in-scope charges, the airport charges benefit associated with transposing the ACD is estimated to equal €260 per flight in terms of a normal full-service flight, and €330 for a typical low-cost one. These outcomes do not mean that airport charges declined (in contrast, Steer Davies Gleave confirms that airport charges rose on average by 23.3% between 2009 and 2016), but rather that without the ACD, the expected increase would have been even worse.

The effects of the Airport Charges Directive have been proven to be statistically significant, but only for airports that serve between 5 and 20 million people. It is more likely for large airports to have market power; studies have not demonstrated a statistical effect due to the ACD being transposed.

Conti et al. (2019) further refine the analysis of the ACD's impact on charges: Since ACD implementation has not been uniform across member states, they show that if member states that did not fully or properly transpose the ACD (states that received formal notice from the EU) reached the level of the state, which implements all requirements, their airport charges would be lower than the current level by an amount estimated to range from 14% to 17%.

In sum, charges would have been even higher without the ACD, and are likely to remain high in EU member states where there is inadequate implementation and/or enforcement of the ACD.

Thus, it was possible to come up with a rough estimation of these potential savings for airports in countries that received a formal notice from the European Commission, multiplying the mean value

of airport charges[10] by the number of passengers and by the size of percentage savings (about 14%) in terms of full recovery for the effect identified by Conti et.al (2019). Assuming that within these member states, the lack of transposition has affected the airport charges of all airports covered by the ACD, we quantify savings at **around €2 billion per year**. If we limit the impact only to airports with a number of passengers ranging from 5 to 20 million (as in Conti et al. 2019), the savings amount to €1.2 billion.

Furthermore, the generic nature of the ACD's principles and its inconsistent implementation across member states caused the ACD (as stated in the ex-post evaluation) not to meet all of its goals, subsequently not delivering all its anticipated benefits. Other studies confirm that consistent benefits related to the ACD can only be achieved through a better, more homogenous implementation of the directive, appropriate enforcement and possibly after a reform.

In 2016, the same European Commission began to appraise the ACD and determine its influence in view of a possible revision. In 2018, the European Commission launched a consultation[11] in order to ensure that more stakeholder groups could express their opinions on the ACD and propose possible ACD improvements. The impact assessment is expected to be completed in the first semester of 2020.

[10] 'Analysis of airport charges' – commissioned by A4E (Aviation economics, 2016). The study estimated airport charges per passenger to equal €36.19 in 2015, considering the 21 largest European airports, which account for over 50% of EU passengers overall.

[11] https://ec.europa.eu/transport/modes/air/consultations/public-consultation-charges-use-airport-infrastructure_en

3.3 Conclusion

The EU's efforts to harmonise the establishment of procedures for airport charges led to the adoption of the Airport Charges Directive. Ten years later, several evaluations of the ACD point out a clear need to reform it by giving greater power and independence to ISAs, specifying the process for fixing airport charges and including a formal assessment of airports' market power.

Some of the trends regarding airport charges and profitability signal the ACD's poor effectiveness. This implies that the misuse of market power may persist among some airports. Furthermore, **ISAs' lack of power, as well as a divergence in the powers between them, undermine the fundamental prerequisite for effective regulation.** Hence, potentially excessive charges could result due to a lack of effective regulation/power, in addition to a plethora of unevaluated **hidden costs** for airlines/airport/users, and more generally for all stakeholders involved in the regulation process.

In sum, the level of **airport charges has a deep impact on the competitiveness of European airlines (charges are a non-negligible cost factor); in turn, this influences the cost of air travel for consumers, consequently affecting demand for air transport and general macro-economic growth** (e.g. as shown in the IATA study). The studies on airport charges state that, although considerable progress has been made with the ACD, there are still multiple areas of improvement, and further integration is needed to make the process of defining airport charges clearer, more transparent and cost-effective, culminating in both internal and external benefits (socio-economic benefits) for the aviation industry.

A possible estimation of costs in the aviation industry, related to the non-homogeneous transposition of the current ACD, as described above, could range from **€1.2 to €2 billion,** assuming that less compliant countries (those that received the notice) conform with the target.

In terms of evaluating economic impact, we adopted a prudential approach: Even if the reports mentioned above imply room for an EU regulation regime that would reduce current airport charges (by generating savings for airlines), we base our estimates on works that analytically connect the marginal trends of airport charges to the incomplete application of the ACD (i.e. €1.2 to €2 billion in annual savings).

Nevertheless, although it remains unquantified in terms of cost via the existing literature, we cannot neglect the possibility that **the studies reviewed underscore the risk of some large EU airports still charging excessively.**

For the overall socio-economic impact, since airport charges produce short and long-term negative effects (see the above, IATA [2017]) – not limited to those triggered by the full cost being passed on to customers through fares – **we can safely deduce that the socio-economic impact would definitely be greater than €2 billion.**

Table 12 depicts the yearly overall impact (comprised of socio-economic effects and the outcome for the aviation industry) of airport charges.

Table 12 – Overall ranges of the economic impact regarding airport charges

Airport charges	Main reference	Yearly impact on industry (€m)		Yearly overall impact (Industry + Socio-economic impact) (€m)	
		Low range	High range	Low range	High range
Non-uniform ACD transposition	Conti et al. (2019)	1,200	2,000	>1,200 (100% cost pass through)	>2,000 (100% cost pass through
Overall		**1,200**	**2,000**	**1,200**	**2,000**

4 Aviation taxes

Aviation taxes are a debated issue because they can generate controversial effects. In general, taxes lead to lower demand and have different economic impacts, both in the aviation sector and externally. Aviation taxes mainly influence passenger demand, the number of flights and connectivity, employment (both direct and indirect), GDP and fiscal revenue, indirectly impacting emissions, albeit this latter outcome appears small and less proportional compared to expectations (see the scientific literature discussed below).

The highest average tax rates are those applied in the UK followed by Germany, Italy, Norway and France. The European Commission recognised the importance of aviation taxes in its Aviation Strategy for Europe (EC, 2015), where it states: 'current aviation taxes and levies applied by Member States over and above the normal profit tax may negatively impact connectivity and competitiveness'.

Importantly, European aviation does not have a unique taxation regime. Today, dissimilar tax systems characterise the EU's members. Many countries have specific taxes and charges that vary across ticket taxes, VATs, taxation on aircraft fuel, environmental taxes and taxes for air cargo. This results in a fragmented internal market, in turn affecting the competitiveness of EU aviation.

The European Commission's report '*Taxes in the field of aviation and their impact*' (2019b) reviews existing taxes in member states. The most applied taxes, levied in 17 member states, are VATs and taxes on domestic aviation. Six member states levy taxes on international aviation in the form of ticket taxes for passengers departing from airports in the member state. Compared to other parts of the world, Europe has the highest level of ticket taxes (*'A study on aviation ticket taxes'*, CE Delft, 2018).

The presence of different tax schemes in some of the EU's member states could bring about extra costs regarding tax burdens and impact demand in European aviation. These elements include bureaucracy, complexity costs and the inability to set up the highest performing network structure.

4.1 Main documents analysed

This section assesses and quantifies the extra costs related to the presence of aviation taxes across Europe by analysing reports that focus on the topic.

The two main studies examined are:

- '*Taxes in the field of aviation and their impact', European Commission (2019b)*
- '*The economic impact of air taxes in Europe*', *PwC study for Airlines for Europe (2017)*

European Commission (2019b)

‘Taxes in the field of aviation and their impact”

The European Commission’s report ‘Taxes in the field of aviation and their impact’ (2019b), by CE Delft and SEO Amsterdam Economics, analyses the economic and environmental effects of taxes and tax exemptions for aviation in all EU member states and for the EU28 on average.

Using a partial equilibrium model (that does not consider feedback loops present in the economy or the EU ETS for aviation), the study determines **the impact of abolishing ticket taxes in EU28**. Regarding ticket taxes, the study examines the taxes imposed on all air passengers that benefit national (or regional) government treasuries. As there is no EU-wide taxation regime, the study ascertained the impacts on the EU28 by aggregating taxation and other data from each member state. Thus, the model treats EU28 as a single country.

The study models the economic effect of abolishing ticket taxes as **a revenue-neutral tax reform in which the lower fiscal revenue is recouped though lower government expenditures or higher taxes**.

Although tax neutrality is an accepted concept in principle, in practise, pervasive deviations exist. Traditionally, tax systems have strived to be neutral, but in most circumstances, they cannot achieve this goal. Acknowledging the multiple dimensions of tax neutrality – such as the allocation of savings, the timing and amount of savings, and administrative feasibility – most of the time, tax neutrality is a purely theoretical notion (Leape, 1990). Relying on this hypothesis in terms of aviation taxes seems especially critical, since the effects are rather complex. **The depression effect – generated both in local activities and in the level of inbound traffic (tourism and business) – produces direct, indirect, induced and catalytic impacts on the economy. It is unrealistic to assume that these impacts will be compensated for by spending taxes raised in other sectors. Without analytical evidence, this hypothesis does not hold**.

Study results

With the limitations discussed above, the study outcomes are as follows:

The model reveals that tax exemptions for the aviation sector lead to higher passenger demand, a bigger aviation sector (both in terms of jobs and value added) and more flights. For the wider economy, this means increased connectivity, which is correlated with a higher GDP. These impacts, however, are counteracted by the fact that tax exemptions for one sector, due to the revenue-neutral tax reform hypothesis, imply lower government spending or higher taxes for other sectors, which affects them negatively (both regarding jobs and value added).

Overall, the analysis predicts that new or increased aviation taxes will generally have a negative effect on the aviation industry (lower direct employment and direct value added), but their impact on overall employment in a member state, on fiscal revenue and GDP, is assumed to be zero due to the fiscal neutrality hypothesis.

If all aviation taxes in the EU were abolished (the current weighted average aviation tax in the EU across all member states amounts to €11 per ticket), the number of passengers would rise by 4% (+ 27m passengers). This would correspond to an approximately equivalent increase in the number of flights, connections, as well as jobs and value added in the aviation sector. Also, CO_2 emissions and the number of people affected by airport noise would rise respectively by 4% and 2%.

Because of the revenue-neutral tax reform hypothesis and the consequently lower government spending or higher taxes in other activities, most of the increase in jobs would be compensated by a decline in employment in other sectors. The overall impact on GDP would be zero. Table 13 displays the key effects resulting from the abolition of ticket taxes in EU 28.

Table 13 – Main impact resulting from the abolition of ticket taxes in EU 28

Impacts	Average annual variation (Δ)	%
Aviation sector		
Passenger demand	27m	4%
Average ticket price	-€11	-4%
Number of flights		4%
Employment (1,000 FTE)	14	4%
Value added	**1.7 € bn**	4%
CO_2 emissions	5.8 Mton	4%
Aviation-related fiscal revenue	-€7.4 € bn	-74%
Total economic impact		
Employment (1,000 FTE)	0*	0%*
Value added	0 € bn*	0%*

**** Values come from the fiscal neutrality hypothesis***

PwC (2017)

'The economic impact of air taxes in Europe'

'*The economic impact of air taxes in Europe*', commissioned in 2017 by A4E to PricewaterhouseCoopers LLP (PwC), assesses the economic impact of air passenger taxes in Europe.

The investigation is based on a 2013 PwC study[12], updated in 2015, that appraises the economic effect of the air passenger duty (APD) on the UK. Using a computable general equilibrium model, which captures the net economic impact of policy changes, the study simulates the abolition of air passenger taxes across the EEA in 2018 to quantify economic effects out to 2030. The analysis considers air passenger taxes to be every tax paid to the federal government for revenue purposes. Using these definitions, ten countries in the EEA ended up applying it: Austria, Croatia, France, Germany, Greece, Italy, Latvia, Luxembourg, Norway and the UK.

Although the simulation refers to an unrealistic scenario (the total abolition of air passenger taxes in the countries where they are levied), it provides a valid indication of maximum economic benefits, which could be addressed by eliminating air passenger taxes. The authors argue that the model helps us understand how the benefits of cutting taxes would be distributed across different nations.

Study results

The main effects, identified as a consequence of discontinuing air passenger taxes in the EEA, are related to regional real GDP, employment, the regional aviation sector's gross value added (GVA), the number of passengers and national tax income.

Following the elimination of air passenger taxes in the EEA, real GDP increases by 0.07% in 2018 compared to the baseline scenario (no abolition), equal to around €10.5 billion. The increase in GDP is reflected across all sectors of the EEA economy. However, the larger impact is located in the

[12] '*The economic impact of air passenger duty*', PwC (2013). The analysis was updated in 2015.

aviation sector, with a GDP growth of over €4.3 billion in 2020. Table 14 portrays the estimated impact in 2030 on real GDP by sector, resulting from abolishing air taxes in the EEA, compared to the baseline scenario.

Table 14 – Estimated impact in 2030 on real GDP by sector, resulting from abolishing air taxes in the EEA, compared to the baseline scenario

Sector	Impact in 2030 (€bn)	
Agriculture and manufacturing	0.09%	4.390
Utilities and construction	0.06%	0.470
Transport	0.10%	3.719
Aviation	0.87%	**4.302**
Financial services	0.07%	0.866
Tourism	1.40%	5.400
Other services	0.05%	5.714
Total		**24.862**

Under the scenario of fully removing air passenger taxes in the EEA, the general equilibrium model predicts that around 40,000 jobs will be created in 2018, and a total of 110,000 jobs by 2030. Most will be in sectors related to tourism and in countries that have discontinued their taxes. Moreover, the abolition of air passenger taxes is forecasted to add more than €3.4 billion in GVA to the aviation sector in 2018, and €4.3 billion in 2030, compared to the baseline scenario (no abolition).

Although countries that have eliminated air passenger taxes will no longer receive revenue from that area, the tax cut will stimulate broader improvements in macro-economic performance, including employment, productivity, wages and consumption. This will increase revenue from labour taxes, social security contributions, product taxes and profit taxes, thus raising indirect tax revenue. The study shows how of the €6.36 billion that the EEA would receive in air passenger taxes in 2020, €**6.2 billion will be recouped through indirect tax revenue, accounting for around 97%.**

Table 15 summarises the overall impacts quantified in the PwC study. In terms of GVA added, the average effect from 2018 to 2030 is estimated to equal **3.8 €bn**.

Table 15 – Overall impacts of abolishing air passenger taxes in the EEA

Impact	In 2018	In 2030
Impact on GDP (€bn)	10.5	24.9
Employment (jobs)	40,000	110,000
Aviation sector's GVA (€bn)	**3.4***	**4.3***
Impact of tax income (€bn)	-0.16	

Scientific literature and other reports

Several studies and reports have focused on the macro-economic and environmental impacts of taxes levied on aviation. In general, there is a consensus that aviation taxes lower air transport demand (in turn reducing the number of flights and connectivity) and have different economic effects, both in the aviation sector and externally (e.g. changes in employment, GDP and fiscal revenue).

In contrast, the debate on the relationship between aviation taxes and the level of emissions remains unresolved.

Major findings on the topic, as well as evidence that analyses the introduction of aviation taxes into some countries (such as the UK, the Netherlands and Sweden), include the following:

- Mayor and Tol (2007), in examining the impact of the APD in the UK, found that doubling it has a perverse effect on increasing CO_2 emissions, albeit only slightly, because it reduces the relative price difference between near and far holidays. Moreover, the amount of tourists arriving to the UK would fall slightly. The number of tourists travelling from the UK would decline in nearby countries; this drop would only be partially offset by displaced tourists from the UK. The number of tourists leaving the UK for countries farther away would increase.

- Seetaram et al. (2014) demonstrated that, although the objective of the UK's APD is to reduce travel and associated carbon emissions, its effectiveness has been marginal because travellers are prepared to pay more to maintain their demand.
- Using a model on international/domestic tourist numbers/flows, Mayor and Tol (2010) looked at the effect of various climate policy instruments implemented in Europe. The introduction of aviation into the European trading system reduces the number of tourists travelling to the EU in favour of other destinations and causes a significant welfare loss, with a small reduction in emissions. Flight taxes in the Netherlands and the UK engender different substitution effects across destinations, but both nations' policies induce global welfare losses and lower the number of visitors to these countries. Globally speaking, the analysed climate policies do not necessarily lead to a substantial or cost-effective reduction in emissions.
- The CE Delft report 'Economic and sustainability impacts of an aviation tax' scrutinises the economic and sustainability effects of three main variants of an aviation tax against two background scenarios. In all the variants, the aviation tax has a modest, positive impact on Dutch economic welfare and GDP. Furthermore, the tax only has a modest effect on CO_2 and particulate emissions.
- Anger and Köhler (2010) reviewed the impact assessments available in the literature between 2005 and 2009. They considered the proposed introduction of an emissions trading scheme for airlines, summarising the potential environmental (CO_2 emissions) and economic (airfares, demand for airline services, supply of airline services, competitiveness, GDP) impacts. Overall, the effects quantified in the literature are small: CO_2 emissions are expected to decline by a maximum of 3.8%, and the maximum impact on GDP in the EU is 0.002%;
- Using a simulation model of international tourist flows, FitzGerald and Tol (2007) estimated the impact of including CO_2 emissions from aviation fuel in the ETS. The effect on global CO_2 emissions from international aviation is minimal. Furthermore, the number of tourists in Europe would fall by up to 0.6% and would increase in the rest of the world.

4.2 Discussion

The EU's member states have different aviation taxation regimes. Many countries have specific aviation taxes and charges that vary across ticket taxes, VATs, taxation on aircraft fuel, environmental taxes and taxes for air cargo.

In general, taxes produce lower demand and have different economic and environmental impacts, both in the aviation sector and externally. The chief effects of aviation taxes in the aviation industry are reduced passenger demand, fewer flights, less employment and lower aviation-related GDP. Less demand may impact the overall level of CO_2 emissions and the noise caused by aviation (albeit this effect is not confirmed by the scientific literature) and ensures relevant fiscal revenue for governments.

In both studies we reviewed, impacts on the aviation sector (due to the presence of specific aviation taxes in some EU member states) are quantified assuming a total abolition of air passenger taxes or ticket taxes in nations where they are levied. Although this scenario seems unrealistic, it provides a valid indication of maximum economic benefits that could be addressed through the tax abolition, and how the benefits of a harmonised tax system would be distributed across different states.

In terms of eliminating air passenger taxes, for the aviation sector, the PwC study calculates additional GVA, compared to the baseline scenario of non-abolition: around **€3.8 billion yearly (the mean value between the additional GVA in 2018 and in 2030).** The European Commission's study is more conservative, and posits an increase in GVA for the aviation sector of €1.7 billion.

In analysing overall benefits – intended to be comprised of the aviation industry, plus consumer benefits and GDP – the European Commission's study, assuming a fiscal revenue neutral policy, reveals (basically by construction) zero socio-economic benefits due to abolishing aviation ticket taxes. However, the report does not discuss whether ex-post evidence of **introducing/eliminating aviation taxes would confirm that it is worth considering these policies to be fiscally neutral**.

The PwC study outlines a strong, positive overall impact (the aviation industry plus the socio-economic impact) of removing aviation taxes. The general equilibrium model forecasts a mean increase compared to the baseline scenario (in GDP), quantifiable at €16.7 billion per year (the mean value of GDP benefits between 2018 and 2030).

Finally, both studies came to a roughly similar approximation of potential tax savings for airlines and as a consequence for passengers, in terms of abolishing aviation taxes. These savings are determined by CE Delft to be about €7.4 billion for year, and around €6.36 billion by PwC. For the latter figure, it is estimated that 97% of lost fiscal revenue will be recouped by increased revenue from indirect taxes.

4.3 Conclusion

In conclusion, the studies analysed point out the positive effects of removing air passenger taxes on the aviation industry, both in terms of GVA and employment. The estimated socio-economic impact of abolishing air passenger taxes differs between the two studies, mainly due to the neutral fiscal policy hypothesis assumed in the EU Commission's study. Given the diverging results, we believe that the effect predicted by using the fiscal neutral policy assumption should be corroborated with stronger empirical evidence.

Globally, based on the reports reviewed (EC 2019b and PwC 2017), yearly **benefits for the aviation industry** of discontinuing ticket taxes across EU member states could reasonably be approximated to range **between €1.7 and €3.8 billion**. **These figures represent the forecasted effect prior to the planned increases in French (January 2020) and German (April 2020) aviation taxes in 2020.**

The overall socio-economic impact ranges from zero (accepting the fiscal revenue neutral policy assumption) to €16.7 billion. In the absence of empirical evidence, the zero impact on GDP still appears to be an unlikely scenario. Table 16 portrays the outcomes of both studies.

Finally, regarding non-fiscal neutral reform, the decrease in fiscal revenue due to eliminating aviation taxes would be at least partially recovered by increased revenue from indirect taxes. The PwC study quantified fiscal revenue recovery at 97%.

Impacts on the aviation sector due to the presence of different tax schemes in EU member states could potentially generate extra costs. Unfortunately, no studies have calculated them thus far.

Table 16 – Overall ranges of the impact in terms of eliminating aviation taxes

Aviation taxes	Main reference	Yearly impact on industry (€m)		Yearly overall impact (Industry + Socio-economic impact) (€m)	
		Low range	High range	Low range	High range
Effect of abolishing aviation taxes*	EC (2019)	1,700	1,700	0 (fiscal neutrality assumption)	
Effect of abolishing aviation taxes	PwC (2017)	3,800**	3,800 **	16,700***	16,700***
Overall aviation taxes		**1,700**	**3,800**	**0**	**16,700**

**** Simulation involving ticket taxes (VAT assumed to remain as today)***
***** GVA (average 2018-2030)***
****** Effect on GDP***

5 Border controls and visa policies

A further issue concerning CONEA is related to the inefficiencies arising from border controls and visa policies.

Based on IATA's Global Passenger Survey (2019), passengers consistently point to airport security and border controls as the worst part of travelling. Security screening and border controls are recognised as the most annoying part of trips due to the numerous questions made by passport officers, the increased wait times and the search of personal items. Passengers are very sensitive to controls; 40% complain about introducing small variations into traditional screening processes.

All of these frictions have been mitigated since the Schengen Agreement was introduced in 1985; it allows passengers to travel within member states without inbound or outbound passport controls, stamps or visa requirements, making travel quicker and easier. Generally, travelling from one Schengen area to another has become similar to flying domestically. However, the high numbers of migrants that have entered the EU's borders in recent years, and the ongoing consolidation of formal control practises, have revealed the structural deficiencies of Europe's current external borders. The absence of a centralised 'command and control' has led to a fragmented system that lacks appropriate border surveillance standards and operational coordination for immigration. This has been accompanied by increased costs related to visa requests and increased filing requirements.

The European Parliament has recognised that although the legal framework aimed at regulating EU member states' coordination can be considered solid and aligned with international standards, its implementation and enforcement suffer from substantial shortcomings.

All of these deficiencies, the continuous threat of terrorism attacks, and increased immigration inflows, have led several Schengen member states to temporarily re-introduce internal borders, in turn raising the costs associated with European fragmentation (the costs of non-Schengen).

Figure 6 maps all Schengen member states, highlighting those that temporarily re-introduced internal borders in 2016.

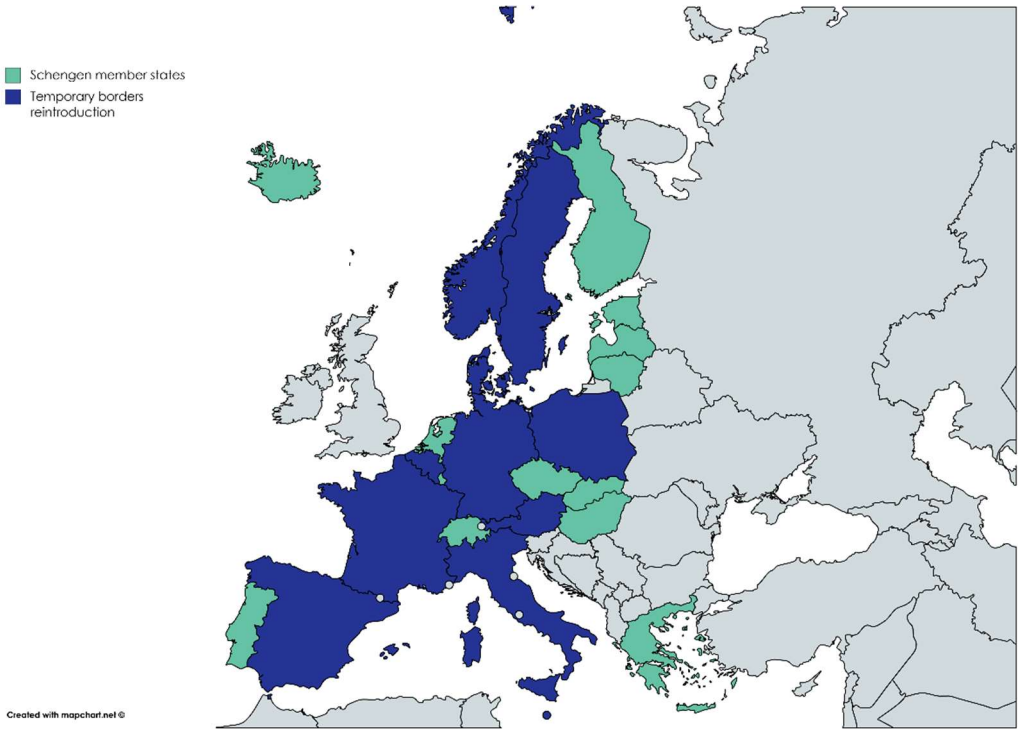


Figure 6 – Schengen member states that temporarily re-introduced internal borders

5.1 Main documents analysed

In this section, we review the main contributions related to the costs of non-Schengen in the area of border controls and visa policies:

- '*The cost of non-Europe in the area of border control and visa policy', EAVU (2019):* This report was produced by the European Added Value Unit (EAVU) of the European Parliamentary Research Service (EPRS) for the Parliament's Committee on Civil Liberties, Justice and Home Affairs. It monetises the inefficiencies associated with border controls and visa policies in Europe.

- '*Member states' notifications of the temporary re-introduction of border control at internal borders', European Commission (2019c)*: This report lists all the notifications of the temporary re-introduction of border controls at internal borders pursuant to Article 25 et seq. of the Schengen Borders Code by country. The duration and reason/scope of the border re-introduction are also reported.

The EAVU's report identifies a number of policy options for the EU to tackle identified gaps and barriers. Once costs are considered, the net benefit of adopting these policy options would be at least €10 billion per year, where almost €4 billion is associated with border controls, while €6 billion is linked to visa policy issues (Table 17).

The estimate aggregates the different types of impacts, from those that are more individually oriented (weak protection of rights and freedoms) to those that more generally deal with the economic impact upon member states. At the individual level, the cost components add up to between €4.3 and €5 billion, while the economic effect on average accounts for €5.67 billion.

Table 17 – Summary of identified costs of gaps in border management

Type of impact	Cost component	Estimate
Personal Impact		
Smuggling of migrants	Financial costs to migrants	Average level: €300 m to €1 bn
Deaths at sea	Value of statistical life calculation	2017: €4 bn
Fundamental rights	Infringements of the rights to dignity, non-refoulement, liberty, privacy, data protection, asylum, effective remedies	
Economic Impact		
Border management and funding costs	Costs related to controlling irregular immigration	-
The economic impact of re-imposing Schengen borders	Delays for individuals and businesses, border infrastructure and officers	Two-year suspension in 5 member states: €386 m
Returns	Average cost of returns	€344 m
Detention costs	Detention costs per day	€340 m
Costs of organised crime	Cost of human trafficking and profits	Sum of costs, lower bound estimate: €4.6 bn
Total		**€10.3 bn**

While almost €10 billion represents the cost of non-Europe in the area of border of controls and visa policies, only part of it relates to the aviation industry. Some of these components are inevitably not tied to the aviation sector (such as deaths at sea or the smuggling of migrants), while others are only partially linked to it (returns and detention costs).

To quantify the cost of non-Schengen for aviation, a conservative perspective is employed by focusing on the component that includes 'delays for individuals and businesses, border infrastructure and officers', which is worth €386 million. However, part of this may be due to the costs that passengers bear using different transport modes. We roughly estimate the costs linked to aviation by considering how many trips are performed in the Schengen area each year by air compared to other transport modes. Table 18 depicts 2015 data on trips made by ferry, rail, bus and coaches, and private cars in Roelstraete (2016). Data on air transport have been gathered from the OAG

dataset. The number of international passengers in Europe is estimated based on the total number of intra-community cross-border offered seats (Table 19).

Table 18 – Total number of intra-community cross-border European passengers by transport mode. Source: Roelstraete, 2016

Mode	Passengers within the Schengen area (m)
Ferry	50
Rail	70
Bus and coaches	85
Private car	850
Total	**1,055**

Table 19 – Estimate of intra-community cross-border European passengers by air. ICCSAI elaboration of the OAG data.

Dimension	('000)
a) Tot. EU seats	1,852,013
b) Total pax EU	1,456,009
c) Avg. Load Factor (b/a)	78.6%
d) Tot. seats EU	232,774
e) Tot. domestic seats EU	734,633
f) Tot. internat. Europe (e-d)	501,860
EU pax within EU (f * g)	**394,550**

The aviation industry accounts for 24.9% of all intra-community international passengers. Relying on the EAVU's report (2019) and what has been taken up by the European Parliament ('Europe's two trillion-euro dividend: Mapping the cost of non-Europe, 2019-24', European Parliament, 2019), we thus weigh the costs of the economic impact of re-imposing internal Schengen borders for the aviation component, and predict that the associated cost is worth €96.44 million per year. This value increases up to €255 million if we include costs related to retention and detention, two components that only partially deal with the aviation sector.

As far as the temporary re-introduction of border controls is an increasingly frequent 'exception' to respond to specific threats in recent years, an estimate is also provided based on the total number of days for which internal borders are re-introduced by country. In filtering the list of the temporary re-introduction of border controls, made available by the European Commission (2019c) for the period of 2016 to 2019 and only considering notifications dealing with the aviation sector, Table 20 portrays the descriptive statistics by the country affected. Overall, the number of country-days of borders being re-introduced equals 4,438 (against 39 notifications). The total number of yearly intra-community cross-border passengers impacted by notifications is predicted to nearly equal 145 million.

Table 20 – Total number of intra-community cross-border passengers affected by borders being re-introduced by country

Country	Days on which borders are temporarily re-introduced	Number of notifications	Passengers affected yearly ('000)
France	1,485	9	74,249
Sweden	942	8	15,356
Norway	775	6	9,069
Denmark	512	4	8,246
Germany	362	2	30,575
Austria	190	3	2,780
Poland	59	3	1,270
Belgium	59	1	1,000
Italy	20	1	1,242
Malta	19	1	81
Spain	15	1	1,526
Total	**4,438**	**39**	**145,394**

By assuming that the re-introduction of borders only accounts for €2 per passenger (the increase in the value of time due to additional security checks and visa practises), the cost of non-Schengen in the area of border controls and visa policies is worth €290 million, and even close to €1 billion (€872 million) per year when considering €6 per passenger.

5.2 Conclusion

Estimates in the area of border controls and visa policies demonstrate that when considering the EAVU's evaluation, based on delays for individuals, businesses, border infrastructure and officers, the costs of non-Schengen range from €96 to €255 million per year (under the hypothesis of a two-year suspension: 5 member states). However, when elaborating on re-introducing internal borders temporarily (2016-2019), and taking into account a conservative value of time for passengers due to the presence of additional checks and security controls, the estimate ranges from €291 million (€2 per passenger) to €872 million (€6 per passenger) per year.

By accounting for the overlap that potentially characterises the two estimates (considering half of the estimate dealing with delays for individuals and business from the EAVU's report), the yearly overall impact in the area of border controls and visa policies ranges from €339 to €1 billion (Table 21).

Table 21 – Yearly overall impact of border controls and visa polices

Border controls and visa policies		Yearly overall impact (Industry + Socio-economic impact) (€m)	
Main reference	**Dimension**	**Lower range**	**Upper range**
European Added Value Unit (2019)	Border controls and visa policies, costs of non-Schengen	48 (i.e., 50%)	127 (i.e., 50%)
European Commission (2019c)	Temporarily re-introducing internal borders	291 (€2 per pax)	872 (€6 per pax)
Overall		**339**	**1,000**

6 Implementing the Union Customs Code

Established in 1968, the UCC is one of the pillars of the EU and lies at the heart of the internal market, providing a stable foundation for economic integration and growth across the continent. In 2017, customs administrations throughout member states handled approximately 332 million customs declarations, accounting for 15% of world trade, with a total value of €3.7 trillion (Eurostat, 2017). Air transportation plays a key role in the movement of goods intercontinentally, accounting for 25% to 29% of the EU's import and export trade, respectively, such that any improvement to customs procedures (e.g. streamlined and paperless processes, lower processing times) and increased volumes will likely have a significant impact on aviation.

The UCC is founded on four main principles:

1. No customs duties at internal borders between EU member states
2. Common customs duties on imports from outside the EU
3. Common rules of origin for products from outside the EU
4. A common definition of 'customs value'

Despite these principles, the customs environment in Europe is still highly fragmented. In practise, day-to-day operations are handled by 28 national customs services and more than 2,100 EU customs offices (land, air and sea). To further enable international trade to/from Europe in the intervening years, a vast body of EU legislation has been developed and implemented (and other initiatives have sought) to facilitate the flow of goods across external borders by boosting collaboration between the European Commission and member states, as well as among member states themselves.

An important step in this regard is the development and harmonisation of centralised information technology (IT) systems. The EU-wide electronic exchange of customs declarations began with the New Computerised Transit System (NCTS), launched in 1997. A few years later, the e-Customs

Decision set the basic framework for creating a paperless environment for customs and trade, which evolved into the UCC to complete the shift by customs to a paperless, fully electronic and inter-operable environment.

6.1 Main documents analysed

In terms of the UCC's potential implications for aviation, a number of official documents have been analysed:

- **European reports**: Based on the *'Evaluation of the electronic customs implementation in the EU'* (European Commission, 2015) and *'Union Customs Code—European implementation assessment'* (European Parliamentary Research Service, 2018), official EU documents and studies represent the primary references to implement actions and assessments related to initiatives to harmonise customs.
- **Scientific literature**: Academic publications have focused on the impact of customs procedures on trade flows, providing a methodology and benchmarking data to determine the degree of harmonisation of customs procedures among EU member states.

6.2 European reports

The UCC represents the new framework for regulations on the rules and procedures for customs throughout the EU, and covers most projects that were previously introduced by the e-Customs Decision. The UCC legal package went into effect on 1 May 2016; the time limit for the practical implementation of IT measures was set to 2020. Building on existing concepts, the UCC aims for simplicity, service and speed to streamline and harmonise customs legislation and procedures across EU member states (Table 22).

Table 22 – Issues and causes

Issue	Cause
Simplicity	- The UCC clarifies rules, such as those on special procedures and releasing goods for free circulation. - The UCC contains most EU customs legislation in one package and stipulates precise rules of application. - The UCC defines data requirements for customs, pre-arrival and pre-departure declarations, notifications, applications and decisions in an integrated way (e.g. EU Customs Data Model) to assist national customs authorities in adapting the data requirements to their systems.
Service	- To a large extent, the UCC's design has taken into account the daily needs and existing practises of trade. - It introduces modern concepts such as centralised clearance, and offers more uniformity to business. - It reduces the administrative burden on authorised economic operators (AEOs) by allowing for a number of simplifications for customs procedures (e.g. guarantees, self-assessments of customs debt under certain conditions).
Speed	- The UCC strives for further automation of all exchanges and storage of information through additional IT systems that integrate new processes and legal requirements, such as shared services for customs and harmonised interfaces, and EU portals for trade.

Source: https://ec.europa.eu/taxation_customs/business/union-customs-code/ucc-introduction_en

From a practical point perspective, the UCC's IT work programme is based on central systems to be developed (UCC—European Implementation Assessment, 2018):

- The *Customs Decisions System (CDS)* aims to harmonise processes for customs decisions by facilitating consultations and the management of the authorisation process.
- The *Uniform User Management & Digital Signature (UUM&DS)* aims to provide direct, EU-harmonised trader access to different electronic customs systems.
- *Proof of Union Status (PoUS*) aims to store, manage and retrieve all declarations that traders provide in order to prove the Union status of their goods.
- The *Standardised Exchange of Information for Special Procedures (INF)* aims to support and streamline processes of data management and electronic handling for special procedures.
- *Centralised Clearance for Import (CCI*) aims to coordinate the processing of customs declarations for economic operators to centralise their dealings with customs authorities.

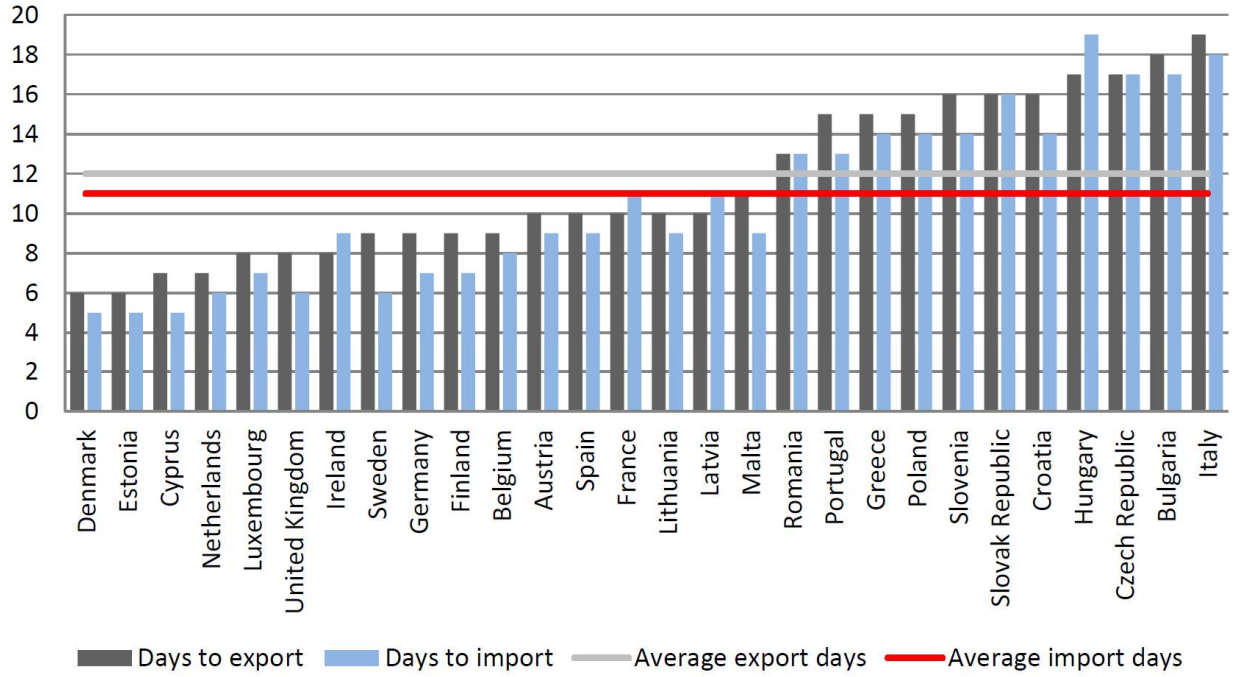
- *Guarantee Management (GUM)* allows for real-time management of customs guarantees across the EU.

7.2 Discussion

One key issue will deliver benefits to many stakeholders, encompassing customs and other border authorities, as well as economic and cargo operators (including airlines). The specific harmonisation-related matters can be summarised into three points *('Evaluation of the electronic customs implementation in the EU'*, 2015):

- The fields and formats required for various customs declarations, or used in different IT systems, differ between member states.
- Although customs operations are electronic throughout the EU, substantial information required by other authorities at the border remains paper-based in some member states and is highly variable.
- A lack of harmonisation, leading to burdensome customs operations and regulatory complexity, imposes economic costs on economic operators and stakeholders in general, causing them to outsource certain customs operations or to institute complex, costly internal operations and processes.

To judge the efficiency of customs procedures and harmonisation among EU member states, a good proxy is the overall time to comply with procedures for importing and exporting. The average time to comply with import procedures is around 11 days, and 12 days for export procedures *('Evaluation of the electronic customs implementation in the EU'*, 2015), with considerable variation among EU member states (Figure 7).



Source: *'Evaluation of the electronic customs implementation in the EU'*, 2015.

Figure 7 – Differences in the time to comply among member states

Reducing the number of days required to clear borders leads to direct operational savings, and also lowers monetary and opportunity costs. In addition, less time to release goods at the border can have significant impacts on trade. As a monetary quantification of the wider benefits of harmonisation at the macro-level, Bourdet and Persson (2012) estimate that every 1% decrease in the number of days it takes to satisfy trade-related compliance obligations increases import volumes into the EU by around 0.44%. Applied to 2017 figures (Eurostat, 2017), Bourdet and Persson's findings imply that a decrease from 11 to 10 days to release imports (a decline of around 10%) would result in around €81.8 billion more imports to the EU28, of which approximately €21.1 billion would be carried by air (elaboration based on import carrying transportation modal split, Eurostat, 2017)[13].

[13] Please note that elasticities from the study by Bourdet and Persson (2012) do not consider the effects of customs-related delays separately from other import delays. Therefore, it is not possible to isolate the effects of trade-related compliance. The figures are intended to illustrate the order of savings, rather than provide precise estimates.

6.3 Conclusion

Despite the widely acknowledged benefits to be gained from implementing the UCC, a monetary evaluation of related benefits is lacking. As reported in a document prepared by the EPRS (*'Union Customs Code: European implementation assessment'*, 2018): '*the UCC had not been subject to a cost-benefit analysis, nor had its related delegated act and implementing act been subject to an impact assessment. Moreover, should the analysis be limited to quantifiable operational gains, the benefits are likely not to exceed the cost of implementation*'. To get a more complete perspective, one should also consider broader benefits linked to the higher-level goal of facilitating import and export procedures and thereby increasing trade. However, as shown above, here, the problem is twofold: (1) to properly infer the induced increase in trade and (2) to robustly calculate the impact on different stakeholders.

For all the above-mentioned reasons, available data do not allow us to isolate the potential benefits of implementing the UCC for aviation. Such implementation is valuable not only in itself, but also represents a key component of carrying out more general, comprehensive, industry-wide initiatives to boost the digitalisation of the air cargo industry. For example, the e-Freight project promoted by IATA (2013b) (which aims to build an end-to-end paperless transportation process for air cargo through a regulatory framework, modern electronic messages and high data quality) is constrained by the lack of harmonisation, and views the removal of customs documents as one of its three core pillars. According to the latest estimates (2012), when fully carried out, e-Freight will lead to a paperless supply chain, with a total benefit up to $12 billion globally (e-Freight Handbook, v4.0).

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