AUTORITÀ GARANTE DELLA CONCORRENZA E DEL MERCATO

AGCM

IC56 Sector Inquiry

PRICING ALGORITHMS IN PASSENGER AIR TRANSPORT ON DOMESTIC ROUTES TO AND FROM SICILY AND SARDINIA

Preliminary Report

Executive summary

26 November 2024

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I. OBJECTIVES OF THE SECTOR INQUIRY, ACTIVITIES CARRIED OUT AND MAIN RESULTS

The Preliminary Report outlines the main evidence gathered so far within the framework of the sector inquiry on pricing algorithms in passenger air transport on domestic routes to and from Sicily and Sardinia, launched by the Authority on 14 November 2023.

The investigation aims to verify:

1. the use of pricing algorithms in the revenue management systems of airlines operating the routes under analysis, their main characteristics, as well as any resulting effects capable of hindering and/or distorting competition;
2. the extent to which airlines resort to personalised fares and ancillary services fees, including by means of pricing algorithms, potentially capable of harming consumers;
3. the degree of transparency and comparability of airline fares (both for the passenger transport service and the ancillary services), particularly with regard to the ways they are made known and accessible to the public and how they affect consumers' purchasing decisions and the mobility of demand, and the potential effects on the sector's competitive dynamics.

Based on these objectives, the Authority carried out its **inquiry** on several fronts, also by resorting to statistical, economic and technical analyses, with the aim of gaining a better understanding of market features and dynamics, as well as their interaction with the revenue management tools adopted by the companies.

The first step consisted in examining the characteristics of the air connections between the peninsula and the major islands, as well as the competitive structure of the markets, also based on the passenger traffic data provided by Enac (the Italian Civil Aviation Authority) and the information provided by Assoclearance (the Italian Association for the Management of Clearance and Slots), both of which were heard to verify the existence of any distinctive features of the island routes.

Policies aimed at ensuring the so-called territorial continuity were also analysed, through specific hearings with the relevant departments of the two regions and with the Ministry of Infrastructure and Transport (MIT). Such policies are indeed capable of affecting prices and competitive conditions in the markets under investigation.

The Authority then entrusted the company Doxa S.p.A. with the task of carrying out a demand market analysis aimed at understanding why consumers purchase flight tickets to travel along the routes under investigation, as well as their degree of satisfaction regarding the price paid and the transparency and comparability of offers.

With regard to the carriers' pricing policies, the Authority then went on to analyse the characteristics of the revenue management systems used by the airlines, specifically with reference to the type of algorithms used and their functioning. To this end, specific requests for information were sent to the main carriers active in the markets under investigation.

The Authority then entrusted the ITSM - Iccsai Transport and Sustainable Mobility Centre of the University of Bergamo with the task of carrying out a statistical and economic analysis, specifically focused on price distribution and dynamics, also intertemporal, of passenger air transport services relating to domestic routes to and from Sicily and Sardinia, also in comparison with other domestic routes with similar characteristics. The study was

carried out on the basis of data concerning tickets sold for the years 2019 (pre-pandemic) and 2023, provided directly by the carriers.

As for price personalisation and customer 'profiling', a technical-empirical analysis on the functioning of the price algorithms adopted by the airlines (algorithmic auditing) was carried out by ML Cube s.r.l., a company accredited as a research spin-off of the Politecnico di Milano.

Finally, with regard to the transparency and comparability of fares and fees offered to consumers, the investigation consisted in taking screenshots of flight searches and bookings on the websites of the main carriers as well as on some metasearch engines.

Below is a summary of the **main results** of the analyses conducted so far, with reference to the above-mentioned areas of investigation.

1. Pricing algorithms in revenue management systems

The study on the functioning of pricing systems confirmed the adoption by all airlines active in the markets under investigation of techniques that dynamically adapt ticket prices over time (revenue management). However, the revenue management systems are equally applied by each carrier on all routes, without any specific adjustments for routes to and from the major islands, in terms of pricing criteria, systems and definition mechanisms.

The investigation found that the revenue management systems used by the various airlines are all still fundamentally based on 'traditional' systems, which envisage the use of matrices or static fare grids by company management and the subsequent dynamisation of prices by means of predefined rules that determine the transition from one fare class to another, without resorting to Artificial Intelligence (AI) and machine learning techniques. Prices can also be changed manually, based on the analysts' assessments of demand and/or booking trends.

The pricing systems used by the various carriers – operating on markets mainly oligopolistic in nature – differ substantially in terms of their functioning, the number of algorithms used and their features, the inputs processed, and the frequency and type of manual intervention by analysts.

Based on the analysis of the actual prices, carriers seem to adopt different policies in terms of price level, distribution of tickets by fare class and intertemporal discrimination strategies. In particular, low-cost carriers have lower average prices, they adopt a more intense intertemporal price discrimination strategy and obtain higher load factor ratios; on the other hand, more traditional carriers use less dynamic pricing strategies, and they tend to have higher average price levels and lower and more dispersed load factor values.

2. The analysis of prices and personalised pricing policies

Analyses carried out on actual ticket prices in 2023 to and from Sicily and Sardinia showed that prices tend to rise significantly during certain periods and days of the year with greater demand, particularly around holidays, weekends, long weekends and during the summer. It is worth noting that the analysis of prices also included tickets subject to public service obligations (PSOs) or eligible for other price subsidies.

The analysis carried out with reference to certain peak demand days – the August bank holiday week and in the holidays at the end and beginning of the year – showed that a significant proportion of passengers paid prices of over €150 or even €200 for a single

flight segment. In this regard, it is worth noting that during peak periods, price trends of flight connections to Sicily and Sardinia do not differ from those observed in other similar domestic air transport markets.

These peak prices appear to occur in certain periods of the year; the data covering the whole year show that the average price of an airline ticket for island routes is around *[60-80]* euros, and that the majority of passengers paid less than €100, while only a small percentage paid more than €150. Nevertheless, at peak periods, buying a ticket in advance allows for savings, even if the basic prices are higher due to increased demand forecasts and there are price differences among flights, depending on different timetable/airport/carrier combinations.

Airline ticket prices are, however, affected by territorial continuity policies benefiting residents (or similar categories): in Sardinia PSOs have been imposed on the main routes to the mainland and social subsidies (in the form of discounts/refunds) were introduced at the end of 2023 on routes not covered by PSOs; in Sicily, PSOs are currently only provided on routes between the minor islands and Sicily, but residents can still benefit from social subsidies on routes to and from the mainland. The analyses – with particular regard to PSOs in Sardinia – have shown that territorial continuity policies can play a role in containing prices during peak periods, albeit mainly to the benefit of residents and similar categories.

With regard to "personalised pricing", the analysis did not reveal (with limited exceptions) the adoption of customer "profiling" based on information acquired during web browsing activities, the type of device or browser used, internet connection location and browsing history.

A price variability was found, and it can likely be traced back to the dynamic intertemporal adaptation of prices themselves, as well as to the use – by some operators for certain services/periods – of tests aimed at analysing the elasticity of demand. The latter consist in simultaneously showing consumers different price offers for the purchase of the same product (flight or ancillary service), assigned to each user with a random criterion (so-called A/B test).

3. Price transparency and comparability

The investigation revealed a lack of comparability of the prices of airline tickets and individual ancillary services (seat selection, luggage, etc.) displayed to users – both between prices offered by different carriers and when comparing prices of a single carrier.

In particular, flight purchase tests on the websites of the carriers under investigation have shown that the fare options offered by each carrier are not always comparable, in terms of the available ancillary services and the fare rules; that the ancillary services offered by the carriers are not always homogeneous (for example, with regard to the weight of carry-on baggage and checked baggage); that none of the carriers in question communicates the fee of the ancillary services on the first page of the flight search results; and that, in order to be able to view the fees of the ancillary services, consumers must start the itinerary search process on the initial webpage and follow a number of 'mandatory' steps, thereby consulting a series of webpages.

Consumers wishing to compare the prices offered by different airlines, based on the purchase options available, will therefore have to go through the booking process – more than once at times – and fill their shopping basket to discover the final price for the basic service and the selected ancillary services, with clear consequences in terms of time spent searching for the best available price solution.

Lastly, it was found that carriers use a different terminology when referring to the following components of the final price: “air fare”, “taxes”, “airport charges” or “other charges, surcharges or fees”.

The sample survey carried out on the characteristics of demand revealed a certain dissatisfaction on the part of consumers (especially those who paid higher prices or deemed the price they paid to be too high) regarding the transparency and comparability of flight prices, mostly due to the variability of prices themselves, the lack of clarity regarding the cost of individual charges and ancillary services, and whether or not these were included in the final price. Overall, the interviews have shown that users are particularly sensitive to price, they tend to purchase a ticket well in advance and to make several comparisons between different flight solutions, thus revealing a strong interest in the conditions of transparency and comparability of available offers.

This Executive Summary presents the main contents of the Preliminary Report.

II. CHARACTERISTICS OF AIR ROUTES BETWEEN THE MAINLAND AND THE MAJOR ISLANDS

Market structure of the air connections to/from Sicily and Sardinia. Air connections between the mainland and the major islands account for a significant share of national passenger traffic, namely 40% for Sicily and around 20% for Sardinia (data for the year 2023).

In both cases the leading carrier is Ryanair, with a market share of *[55-60%]*[*] and *[35-40%]* respectively. ITA follows with a *[15-20%]* share in Sicily and *[20-25%]* in Sardinia. The other operators with lower shares are EasyJet, WizzAir, Volotea, Aeroitalia and Vueling in Sicily; the same carriers, with the exception of Vueling, also operate in Sardinia, again with limited market shares.

Changes occurred in 2023 compared to 2019 – some of which substantial. These can be traced back to the substantial reduction in the flag carrier’s presence, the strengthening of Ryanair, as well as the turnover among some carriers with smaller shares. These markets are therefore rather dynamic.

O&D markets and macro-areas under analysis. In line with current EU and national practice, and based on the so-called point-of-origin-point-of-destination (O&D) approach, the return flight routes under investigation were combined into markets by considering catchment areas of 60 minutes or 100 km by car, between the airport and the relevant cities. In particular, the following airports were deemed to fall within the same catchment area: Milan Linate, Milan Malpensa and Bergamo Orio al Serio; Rome Fiumicino and Rome Ciampino; Catania and Comiso; Palermo and Trapani.

The trends of macro-areas which include the markets pertaining to the connections between Sicily and Sardinia and the peninsula were compared with those of certain benchmark macro-areas, such as “other major routes” and “Milan-Rome” (both with a particularly significant number of passengers), or “Insular alike” routes; the latter macro-area was

[*] In this version, some data are omitted, as elements of confidentiality or secrecy of information were deemed to exist.

constructed so as to include routes with features (in terms of distance between point of origin and destination and travel time by alternative means) as similar as possible to those of routes connecting the major islands and the peninsula, so as to resemble the condition of insularity that characterises the connections between the continent and the major islands.

The degree of market concentration. The values of the average HHI (Herfindahl-Hirschman Index) of the markets in the macro-areas of Sicily and Sardinia tend to be in line with some of the benchmark macro-areas examined ("Insular alike" and "other large routes") and significantly lower than others ("Milan-Rome" and "other small routes"). The rather high level of concentration found in the markets connecting the major islands and the peninsula (average HHI between 5,000 and 5,800) is therefore not a specific element of concern for these connections.

By looking at the domestic markets as a whole, an inverse relationship between HHI and market size can be observed. In this context, the markets of the macro-areas of Sicily and Sardinia, as well as the main markets included in the benchmark macro-areas, tend to have an oligopolistic structure (frequently 2-4 main operators and possibly some fringe operators). In the smaller markets, on the other hand, there is often only one operator.

The presence of high market concentration ratios – even more so in smaller markets – may also be linked to the fact that market entry in this sector requires a minimum efficient scale due to, *inter alia*, the need to offer a minimum number of flights on the route, fixed costs (including those for aircraft, crew and aircraft parking and maintenance at the airport, optimised also among several return routes) and the need to maximise the hours flown by aircrafts. Moreover, entering a market requires advance planning, arranging flights at least for a whole season and it also depends on the degree of congestion of the relevant airports. In Sicily and Sardinia there is a certain level of congestion, in light of the so-called grandfather rule, according to which, on condition that they use the slots assigned to them for at least 80% of the time, carriers who are already active in a given airport stopover are given the right to continue to use such slots.

The characteristics of air traffic flows. Air traffic flows in Sardinia are more seasonal than in Sicily, where seasonal trends are not dissimilar to those found in the other macro-areas. In terms of the number of people taking same-day return trips, presumably for reasons other than tourism (e.g. for work, health or study reasons), the two regions do not show obvious differences compared to the other macro-areas: the share of passengers taking same-day return trips has a relatively limited impact on these markets, with the sole exception of Milan-Rome, where this figure is higher.

III. POLICIES FOR TERRITORIAL CONTINUITY

Policies for territorial continuity. The presence of policies aimed at ensuring territorial continuity – public service obligations (PSOs) and social subsidies – affects price dynamics and competitive conditions in the analysed markets. The *rationale* behind PSO programmes and social subsidies is different, and they lend themselves to being used in a complementary manner, subject to availability of resources.

PSOs. The *rationale* behind the imposition of PSOs lies in the need to provide air transport services where they would be insufficient in terms of frequency, seats and prices, if they were left solely to the free market and profitability (e.g. the need to have same-day return connections or connections with a certain frequency for the entire year). If there are carriers that willingly accept these obligations, they can operate on the route in compliance with the relevant conditions (open PSOs); otherwise, an operator must be selected by public tender, with compensation if the case may be (closed PSOs). In Italy, as in Europe, most PSOs are closed.

The imposition of PSOs represents a structural measure that may interfere with the competitive functioning of markets. Therefore, States that intend to impose PSOs on a given route must assess their need and appropriateness, in accordance with EU law principles.

A frequent objection raised by the European Commission with regard to PSOs concerns the extension of fare concessions to non-residents, which, as pointed out by the Ministry of Infrastructure and Transport, are viewed unfavourably, especially from 2018 onwards. In the European Commission's Interpretative guidelines on Regulation (EC) No. 1008/2008 it is made explicit that price obligations must be non-discriminatory and proportional, and that, for example, the application of preferential fares for non-residents (even if native to the islands) is to be considered disproportionate.

Social subsidies. Social subsidies are a measure to the benefit of end consumers, affecting only certain categories of passengers (e.g. people with low income), although – if a route serves to connect remote areas, outermost regions, islands, and sparsely populated areas – they may also cover the entire population of the region concerned.

With a view to protect competition, social subsidies appear to be less problematic, because unlike PSOs they do not require interference in the free market regime and they are directed to all beneficiaries, regardless of the carrier used. Social subsidies benefit residents directly, they can increase traffic on the route and, if substantial enough, they can stimulate the entry of new operators, thus fostering competition. However, it can be costly, all the more so depending on the discounted sum and the perimeter of beneficiaries. In addition, it is worth considering that in particular market structures (for example in the absence of sufficient competitive pressure) such measures may lead to increases in ticket prices for all passengers.

The measures for territorial continuity in Sicily and Sardinia. Both the Sicilian and Sardinian regions implement territorial continuity policies that combine public service obligation (PSOs) programmes with forms of social subsidies.

In Sardinia, PSOs have been imposed on the main connections with the peninsula, on the routes to/from Alghero, Olbia and Cagliari to/from Rome Fiumicino and Milan Linate, while in Sicily, PSOs are currently only foreseen on the routes between Sicily and the minor islands. With regard to social subsidies, at the end of 2023 both regions introduced a discount/reimbursement extended to all residents, on routes not covered by PSOs, in accordance with the provisions of the so-called "Insularity Fund", introduced to ensure the territorial continuity of the two islands, taking into account the newly introduced Article 119 of the Constitution.

Since social subsidies were only recently introduced by the Sicilian Region and the Sardinia Region it is too early to fully assess their effects. The Sicilian Region has, however, highlighted a positive response based on adhesion rates, noting how the measure has

significantly alleviated the burden on end users. Adhesion to the initiative in the Sardinia Region appears to have been more contained during the initial stage; the measure in question only concerns routes not subject to PSOs.

As for the effects on PSO prices in Sardinia, these were examined in a Dedicated In-Depth Study within the framework of the analysis on ticket prices actually sold.

IV. THE MARKET SURVEY ON CONSUMERS' PURCHASING CHOICES FOR AIRLINE TICKETS

The sample investigated. A market survey on the characteristics of demand was carried out based on a representative sample of approximately 1,500 individuals who had travelled on a domestic flight to/from Sicily or Sardinia during the year prior to the survey date, or who were in the process of taking such a trip at the time of the survey.

Demand characteristics. The survey answers showed a prevalence (52%) of individuals who, by birth, residence or domicile, are connected to the island territory from or to which they travelled. Moreover, within this subgroup, about half appear to travel with some frequency on the same route. In the sample as a whole, the majority of users (57%) travelled for tourism or leisure, while this percentage drops significantly (to 42%) in the group of users connected to the territory, who travel for different reasons, linked to work, study, health or family reunion needs.

The distribution of prices. The price paid by interviewees for one flight segment was on average less than €100; it was higher for flights to and from Sicily (€83) than for those to and from Sardinia (€70), partly due to a higher number of users in Sardinia who resorted to the benefits linked to territorial continuity. The €1-100 price range accounts for most of the distribution of prices paid, with more than 3/4 of the survey answers, while only 5% of users paid more than €200 for a single flight segment. As already pointed out, the results of the market survey also include tickets subject to PSOs or other fare concessions.

The degree of satisfaction with the price paid. The participants' evaluation of the convenience of the price paid for the ticket was on average good (3.4 on a scale of 1-5) and inversely correlated with the amount paid. In particular, while 60% of those who spent up to €100 per route believe they paid a convenient or good price, this percentage falls below 30% among those who spent over €200. On the other hand, users who are decidedly dissatisfied account for a rather small proportion of the total number of interviewees; however, a higher percentage, though still below 30%, is found among those travelling for health or family reunification reasons.

Advance bookings of air tickets. The vast majority of consumers purchased their tickets well in advance of their departure date, with less than a quarter of interviewees stating that they had made their purchase in the two weeks prior to departure and that they had done so, for the most part, because they were unable to plan their trip further in advance.

Importance of the price and price comparison when choosing a flight. Price is the element that has the most influence on the final purchase decision, followed by the exact day of the flight and the time of day. As a matter of fact, before purchasing their flight most of the interviewees compared the prices of different travel solutions in order to find the lowest possible price or, at any rate, an acceptable solution. The comparisons were mainly carried out via metasearch engines and/or directly on airline websites. Comparisons mainly concerned the time of departure, the exact days of departure and return, and the airports of departure and arrival. The comparisons involved several searches, in many cases more than 4. Almost all of those who made several searches noted that the price and/or availability conditions of flights tended to worsen as the departure date drew closer and, in more than two thirds of cases, they rushed to purchase their ticket.

Comparability and transparency. Especially among those who paid a higher price, or in any case deemed the price inconvenient, the lack of transparency and comparability of overall flight prices appears to be a critical issue. The latter are substantially linked to their excessive variability from one search to another and to the lack of clarity on the cost of ancillary services, and whether or not these were included in the final price. In particular, among interviewees who compared prices (between different airlines, time slots or other parameters) before purchasing a ticket, around 50% of those who paid between 100 and 200 euros and more than 50% among those who paid more than 200 euros for a single flight segment were dissatisfied with the level of transparency and comparability of prices. Moreover, among interviewees who compared prices prior to their purchase and were dissatisfied with the price paid, 63% also expressed dissatisfaction with the level of transparency and price comparability between different flight solutions.

Consumer profile. On the whole, the results of the interviews seem to show that consumers are particularly sensitive to price and therefore willing to sacrifice some of their preferences – especially in terms of flight times and dates – in order to minimise their spending or, in any case, to pay a convenient price. To this end, where possible, there is a tendency to purchase tickets well in advance and to make several comparisons between different flight solutions, a circumstance that explains the widespread and specific interest shown by consumers in the conditions of transparency and comparability of flight solutions.

V. REVENUE MANAGEMENT AND PRICING ALGORITHMS IN THE AIR TRANSPORT SECTOR

The revenue management systems used by individual airlines. The analysis of the carriers' pricing mechanisms, particularly with regard to revenue management systems and the use of pricing algorithms, showed the absence of any distinctive features in the pricing mechanisms used for flights to and from Sicily and Sardinia. As a matter of fact, all companies stated that they use their own revenue management system for all their routes.

In general, the carriers' use of revenue management systems is extremely complex, varied and also rather flexible, given that they often make more or less significant changes – or at least test such changes – to one or more elements of their pricing system. Therefore, on the whole, the revenue management systems used by the airlines under investigation differ substantially depending on their functioning, the number and characteristics of the

algorithms used, the inputs processed, and the frequency and type of manual interventions by analysts.

As a result, the way prices change over time differs significantly from one operator to another in terms of the frequency, granularity and gradualness of the price adjustments; in some cases, they consist in a series of steps from one fare class to another and, in other cases, in gradual or even seamless transitions between the different values of the initially pre-established fare matrix.

Dynamic pricing mechanisms. An element common to all systems seems to be the use of traditional dynamic pricing mechanisms, characterised by the preliminary definition of a fare grid, within which the price of each flight is made to vary over time by opening and closing bookings for each pre-established price class, while the allocation of the number of seats in each fare class is done using algorithms, inputs, rules and criteria identified autonomously by each operator, with significant differences among them.

In particular, the carriers allocate seats in the various fare classes by processing information (number of bookings, load factor or flight fill rate, past booking trends, route, season, date and time of departure, number of days separating the booking from departure and so on) with the aid of one or more algorithms. Some airlines also use information regarding their competitors' prices, which – as stated by carriers in response to requests for information – they acquire, directly or indirectly through private platforms, from their competitors' websites by resorting to "web-scraping". In some cases, such information is fed into the revenue management system, while, more frequently, it is used for various market intelligence activities.

The input used by the different systems to dynamically change the price of each flight always includes the booking trend of the flight itself. This information is extracted from the booking platform used by each airline. Not all platforms are owned by the airlines themselves.

The degree of automation of revenue management systems. The revenue management systems used by the carriers also differ in terms of their degree of automation. In any case, all systems allow for manual interventions aimed at changing prices based on the company analysts' independent assessment of market trends and the suitability of the price generated by the system. At present, no company appears to use revenue management systems entirely based on artificial intelligence and machine learning. The latter significantly reduce or even rule out any manual intervention. It is worth noting that several carriers are trying out these technologies, albeit with reference to a limited number of functions, services and/or routes.

Ancillary services. The prices of ancillary services (such as seat selection or carry-on or checked baggage) are also, for most operators, subject to dynamic adaptation, through algorithms and operating rules, which also differ from one company to another.

Demand elasticity tests. The variability in the prices offered for the same flight or for the same ancillary service on that flight also derives from experimental tests conducted by some airlines aimed at assessing the characteristics and elasticity of consumer demand. In the vast majority of cases these tests consist in simultaneously showing consumers different prices, randomly selected by the system from two or more predetermined values, for the

purchase of the same product, ticket or ancillary services (so-called A/B tests). These tests differ among carriers in duration and extension (e.g. portion of consumers and routes involved); in some cases, they consist in continuous price randomisation aimed at all consumers.

VI. TICKET PRICES IN SICILY AND SARDINIA

Main characteristics of the analysis. The analysis on the prices of tickets actually sold by carriers offering connections to/from Sicily and Sardinia was carried out using an extensive database, consisting in the micro-data on the prices of all tickets actually sold, supplied directly by the companies. The prices included all services, both the price for the airfare and that for the ancillary services purchased together (net of VAT); since the data pertains to the price of tickets that were actually sold, they also include the prices of tickets sold under the PSO scheme.

The analysis examined average prices and the distribution of tickets sold by fare class; it also investigated the role of intertemporal discrimination – i.e. the variation of prices, which generally rise as the departure date draws closer – in influencing price dynamics. Some in-depth studies were then carried out on the average revenue and load factors (flight occupancy rates), which come to the fore as part of the revenue management practices adopted by carriers when setting prices.

Finally, Dedicated In-Depth Studies were carried out on two topics.

Firstly, since the analyses showed a trend towards a significant price increase during certain periods of the year, particularly in certain days close to holidays (e.g. Easter, Christmas and New Year's Eve), weekends, long weekends and the summer period, a Dedicated In-Depth Study was carried out by selecting certain days close to the *Ferragosto* bank holiday (mid-August) and end-of-year and beginning-of-year holidays, which represent two important peak demand and price periods for flights connecting Sicily and Sardinia.

Secondly, the way in which PSOs affect market outcomes in Sardinia was explored.

The main findings are summarised below.

The average price of tickets to Sicily and Sardinia. During 2023, the average ticket price for a return flight to/from Sicily and Sardinia, including any ancillary services, was *[€60-80]* for Sicily and *[€60-80]* for Sardinia, in line with prices for national routes most similar to the insular ones (Insular alike, *[€60-80]*). With reference to Sardinia, tickets subject to PSOs were also considered; when analysing PSO and non-PSO tickets separately, the average price of non-PSO tickets is in line and equal to *[60-80 €]*, while that of PSO tickets is slightly lower and equal to *[60-80 €]*.

The seasonality of demand means that average prices are very different in the various months of the year: for example, flying between Rome and Catania costs on average *[€40-60*] in January and *[€80-100]* in July. In general, prices are the highest in the summer months, both for Sicily and Sardinia. Furthermore, average prices in 2023 vary significantly among carriers, with the highest average price being up to 80% higher than the lowest average price on the same route.

Price variations between 2019 and 2023. Between 2019 and 2023, there was a general increase in average prices in the markets under investigation. With reference to the routes

to and from Sicily there was an increase of around 16%, lower than that found for routes similar to those connecting the islands (around 19%) and in line with the cumulative inflation rate (around 16%). In the face of the price increase, the number of passengers nevertheless rose in almost all the markets examined (4%), including routes to and from Sicily (6%).

Prices varied among routes and periods of the year. In the summer, the prices of flights to/from Sicily rose by 18.7% in July and 9.9% in August. These figures are lower than the price increases recorded on the most comparable routes (Insular alike).

As far as Sardinia is concerned, it was not possible to calculate the price changes between 2019 and 2023 with sufficient reliability, as the price micro-data for 2019 pertaining to Meridiana/Air Italy (in liquidation) and Alitalia (in extraordinary administration) was incomplete.

The distribution of tickets by price classes. For both Sicily and Sardinia the distribution of tickets by price classes (including PSO tickets) shows that most tickets fell within the lowest price range: as a matter of fact, throughout the year *[70-90%]* of passengers to/from Sicily and Sardinia paid less than 100 € and only about *[up to 10%]* of tickets to/from the islands cost more than 150 €. Furthermore, *[40-50%]* of passengers to/from Sicily and *[30-40%]* of those to/from Sardinia paid less than €50. Tickets over €150 increased especially in the summer months for both regions (reaching *[10-20%]* in August). Instead, in December, such increase was around *[up to 10%]* for Sicily, and lower for Sardinia, presumably due to the presence of PSOs for residents, given that there is a higher percentage of resident passengers benefiting from PSO fares in December.

In Sicily, the distribution of tickets by price range is substantially in line with that of national routes most similar to the insular ones (Insular alike), while in Sardinia, it differs slightly, as there is a greater percentage of tickets in the medium price class between €50 and €100.

Changes in ticket prices depending on the date of booking (intertemporal discrimination). In general, the purchase price decreases as the distance between the time of purchase and the departure date increases. For example, on average, buying a ticket to/from Sicily more than a month in advance allows a saving of around 53% compared with a purchase made in the week before departure; on average, the price of a ticket to Sicily bought over a month in advance is *[€40-60]*, compared with the price of *[€100-120]* for a ticket purchased close to the departure date. Purchases made in the month before, but no later than seven days before departure, allow an average saving of around 43% (compared with the price in the week before departure). The savings potential for advance bookings for flights to/from Sicily is greater for flights in the early months of the year (around 50%) and decreases for flights in the peak months of August and December (around 30%). Similar price dynamics are also recorded for the most comparable routes (‘Insular alike’).

The analysis has however shown that each carrier has its own intertemporal price discrimination strategy. For example, for bookings made 7 to 30 days before departure the saving varies from 30% to 50% depending on the carrier. In general, intertemporal price discrimination is less pronounced in “traditional” carriers compared to “low-cost” carriers. The intensity of price variation depending on the booking date in the different markets is therefore (also) strongly linked the characteristics of each operator. It is also inversely correlated with the level of average and initial prices: in particular, higher average and initial prices are linked to a lower intertemporal price discrimination.

Dedicated In-Depth Study on the *Ferragosto* bank holiday and Christmas. The analyses showed that prices tend to rise significantly during certain periods of the year, particularly on certain days close to holidays (e.g. Easter, Christmas and New Year's Eve), weekends, long weekends and the summer. A Dedicated In-Depth Study was therefore carried out by selecting certain days close to the *Ferragosto* bank holiday in August and the end and beginning of the year holidays, which represent two significant peak demand and price periods for flights connecting Sicily and Sardinia.

The analyses showed that the average price of flights between 11 and 20 August 2023 ranged, for Sicily, from a minimum of *[60-80 €*] (15 August) to a maximum of *[100-120 €*] (20 August), while, for Sardinia, it varied in a range between *[60-80 €*] and *[100-120 €]*; during the Christmas holiday period the days with a higher average price in Sicily are those preceding Christmas, with average peak prices of *[120-140 €]* (23 December).

However, if peak days are identified by distinguishing between flights to the islands (inbound) and those from the islands (outbound) the average daily prices are higher.

For example, on 20 August (one of the peak days for outbound flights), flights departing from both Sicily and Sardinia had an average price of around *[€140-160];* around *[40-50%]* of passengers paid more than €150 (specifically, *[20-30%]* paid between €150 and €200 and *[10-20%]* paid more than €200).

During the Christmas period, the average price for inbound flights to Sicily reached *[€160-180]* on 23 December and more than *[60-70%]* of passengers paid more than €150 (specifically, *[20-30%*] paid between €150 and €200 and *[30-40%]* more than €200). On the same day, in Sardinia the average price for inbound flights was around *[100-120 €]*, with a significant percentage of tickets (around *[60-70%]*) placed in the medium price class (between 50 € and 100 €); this outcome appears consistent with the presence of PSOs.

In both the August and Christmas periods, the intertemporal discrimination is diminished, meaning that savings for advance bookings tend to be lower than in other periods of the year. This is less so for Sardinia than for Sicily, probably due to the presence of PSOs.

In this regard, the analysis has confirmed the inverse relationship between the average price level and the intensity of price variations as the departure date draws closer: as a matter of fact, in the periods covered by the Dedicated In-Depth Study, there was an increase in average prices and a reduction in the degree of intertemporal discrimination, linked to higher initial or advance booking prices compared to the annual average. This appears to be consistent with the fact that the expected demand is quite high from the outset for the most popular flight dates, seeing as they are close to Christmas and the summer holidays.

Even on peak days, there are price differences between the various flights, which seems to indicate that available offers depend on different time/airport/carrier combinations.

A further analysis was carried out also on the basis of the provisions of Legislative Decree 104/2023, which requires a focus on – albeit for the purposes of ascertaining potential agreements restricting competition or abuse of a dominant position – whether "*in the last week prior to the flight, the sale price of the ticket or ancillary services* [is] *higher than the average fare for the flight by more than 200 per cent*". This analysis, aimed at observing the extent of variations in average prices in the last week prior to the flight with respect to the average flight fare, showed that, in almost all cases (98.2%), the average price variations for purchases close to departure (last 7 days), compared to overall average prices, remained below 200%; in the few cases (1.8%) in which this variation exceeded 200%, the overall average prices fell below 100 euro. This outcome is consistent with data on the degree of intertemporal discrimination, which tends to decrease when demand is high.

Load factor. The revenue management practices commonly adopted by carriers in setting air fares aim to satisfy two requirements: on the one hand, maximising a route's profitability; on the other, reaching an adequate load factor for that same route. In other words, the optimal fare (ideally) ensures, over the flight's marketing period, the most convenient balance between the average revenue per passenger and the load factor level. In Sicily and Sardinia, the average annual load factors were respectively 89% and 81%; the level of Sicily's average annual load factor is in line with that of the Insular alike, while that of Sardinia is lower, presumably, also in this case, due to the presence of PSOs.

In general, average load factors on a given route also depend on the mix of operators, as there are significant differences in the levels and variability of load factors between carriers. In particular, the highest and least dispersed load factors are recorded for carriers that apply more intense intertemporal discrimination. Conversely, "traditional" carriers, less inclined towards intertemporal discrimination, show lower and more dispersed load factor levels. Flights to Sardinia show a higher dispersion of load factors, consistent with the nature of the carriers operating there and the presence of PSOs which aim to provide (among other things) residents with adequate services, also in terms of their frequency, even outside seasonal peaks.

The pricing strategies of single airlines. Different carriers appear to adopt different pricing policies in terms of price levels, distribution of tickets by fare class, and intertemporal discrimination strategies. Load factors and average revenue values also differ between carriers. In particular, low-cost carriers have lower average prices, they adopt a more intense intertemporal discrimination strategy and achieve higher and less dispersed aircraft fill rates. In contrast, more traditional carriers use less dynamic pricing strategies, they have higher average prices and tend to have lower and more dispersed aircraft fill rates.

Comparison between Sicily and Sardinia and the more directly comparable markets. On the whole, no distinctive features were found in terms of the level and distribution of tickets sold by price class in the Sicilian and Sardinian markets compared to the Insular alike markets. Some distinctive features were identified in Sardinia and these can be traced back to the presence of PSOs. This seems consistent with the fact that airlines use the same pricing mechanisms for all the routes on which they operate.

Dedicated In-Depth Study on public service obligations (PSOs). Public service obligations impose constraints on operations that affect, whether directly (limits on price levels for residents) or indirectly (constraints on flight capacity and frequency), pricing offers and policies of carriers operating under PSOs.

The analyses have shown that passengers benefiting from PSO fare concessions pay on average 20% to 40% less (depending on the carrier) than non-PSO passengers travelling on the same flights.

Moreover, PSO passengers tend to book a flight close to the date of departure of the flight, as they are not subject to the intertemporal discrimination found with commercial fares. The load factors of PSO carriers are significantly lower than those of free market carriers.

In Sardinia's O&D markets, which include PSO routes, there are usually also carriers operating exclusively in the free market, with prices which are, at certain times of the year, cheaper than the PSO fares, depending on intertemporal discrimination policies.

Overall, tickets at commercial fares tend to be cheaper mostly in the late autumn and winter months, and thus outside peak season for tourism, and in markets where the main low-cost operators are present. In the absence of competitive pressure within the same catchment area, the most significant differences are those between PSO and non-PSO ticket prices charged by the same carrier.

VII. DEMAND PROFILING AND PERSONALISED PRICING

Research objectives. Consistently with the objectives of the sector inquiry, also aimed at identifying any price differentiation and personalisation policies implemented by the airline companies on the routes under analysis, a specific technical-empirical research was carried out to verify whether airline companies used different prices simultaneously. This would entail that two different users who access the airline's website at the same time and with the intention of purchasing the same flight, are presented with two different offers. In particular, the research was mainly aimed at bringing to light any price discrimination based on a user's features, namely the type of device used for the connection, browser brand, location of the connection and browsing history. It was also intended to ascertain whether there were any price discrimination practices in terms of the services purchased, such as ticket type, seat selection, type of luggage, purchase for one individual or for a family.

Fact-finding and analysis methodology. The in-depth study described above was carried out by using fact-finding and analysis techniques aimed at inferring the functioning of the algorithms by examining their outcomes in terms of prices actually offered (so-called algorithmic auditing). These techniques fall under the algorithm screening tools also identified by the OECD, as an alternative or in addition to those that envisage the direct acquisition of information and knowledge relating to the structure and operating characteristics of the algorithms themselves. More specifically, the technical-empirical analysis made use of scraping audit techniques (acquisition of flight prices and ancillary services directly from airline websites) and sock-puppet auditing (implementation of computer programmes that simulate the profile of different users). The data was extracted through searches carried out by simulating the profiles of different users and devices, at different times of the same day, with reference to a set of predefined airlines, routes, flights and periods.

Outcomes of consumer profiling study. The study confirmed the adoption by all airlines of techniques that dynamically adapt airline ticket prices in a continuous manner over time. However, different carriers use these adaptation methods in different ways. Generally speaking, in the vast majority of cases the surveys do not reveal the use of customer 'profiling' practices – in terms of the device used and/or the operating system or the user's browsing history – by the main operators active on routes to and from Sicily and Sardinia.

One exception is an airline company which applies a different pricing policy to users who access its webpage repeatedly compared to users without a browsing history; this seems to indicate that the carrier 'labels' these categories of users, by storing their access history. However, the study has shown that such elements of the user's browsing history are not

used to systematically penalise or benefit those who repeat the same search more than once but only to 'freeze' the price level initially assigned to each user.

Price testing. The ticket price variability was not only caused by the dynamic adaptation of prices over time, but also by the frequent use of techniques that simultaneously offer several prices for the ticket of the same flight, by assigning each user accessing the airline website – with a seemingly random criterion – a price chosen within a range of 2 or 3 possible values (and, in the latter case, such prices are equidistant).

Prices of ancillary services were found to be mostly stable or subject to little upward variations over time for some carriers, and to more dynamic variations for others. The price variability of ancillary services observed for some operators was also found to be largely due to the use of mechanisms for the simultaneous and random alternation of different prices, which differ from one carrier to another.

Other price variability factors. A final price variability factor dependent on a user's features concerns one airline, specifically with regard to the price applied to the seat selection service, where the purchase is made jointly for an adult and a child and the seats selected are those of a higher category. As a matter of fact, in this case, different prices were applied compared to those applied to for the simultaneous booking of a single seat or seats for a couple composed of: adult+adult; adult+adolescent; adult+child. In particular, the adult + child (2-12 years old) combination always entailed the offer of generally higher prices for seat selection than those for the other combinations.

VIII. TRANSPARENCY AND COMPARABILITY OF AIR FARES

Main characteristics of the analysis. As part of the investigation, a specific empirical in-depth study was also carried out to discover how air transport service prices are displayed to the public. In this regard, screenshots of the webpages consulted during a flight search were taken with respect to the main air carriers operating flights between the continent and the major islands. The simulation of flight searches was also carried out through a number of metasearch engines, such as SkyScanner and Google Flights.

The purchase options offered. All carriers under investigation offer consumers both the chance to purchase predefined fare options (in terms of combinations, or bundles, inclusive of the basic transport service, ancillary services and fare rules), and to select, little by little throughout the booking process, the specific ancillary services (seat selection, carry-on baggage, checked baggage, flexibility options, etc.), also with differences in terms of quality/price, to be purchased in addition to the basic passenger transport service (unbundled mode). This allows consumers to flexibly fill their shopping basket according to their needs and willingness to pay but, on the other hand, it makes the flight search and comparison process more complex.

Comparability and search costs. The predefined fare options of each carrier are not always comparable among carriers, in terms of the ancillary services included and the fare rules, and the ancillary services offered by the carriers are not always homogeneous (for example, with regard to the weight of carry-on baggage and checked baggage). Moreover,

none of the carriers in question communicates the price of such ancillary services at the beginning of the flight search activity; as a matter of fact, the carriers offer the basic default fare option (as a rule, the cheapest fare option) on the first page of the flight search results. In order to be able to view the price of ancillary services, consumers must start their itinerary search process on the initial webpage and follow a number of 'mandatory' steps, thereby consulting a series of webpages; moreover, in almost all cases, before being able to access the webpage indicating the price of ancillary services (seat selection, carry-on baggage or checked baggage), consumers must enter their personal data.

When comparing the offer conditions of the same carrier, in both bundled and unbundled modes, differences in prices may emerge. As a result, to be able to identify the cheapest offer, consumers are forced not only to compare offers between different carriers but also to carry out several tests to compare the prices offered by the same airline.

A further complicating factor in the comparison is the fact that carriers use different terminology when referring to the following components of the final price: "air fare", "taxes", "airport charges" or "other charges, surcharges or fees".

Therefore, to compare the offers available on the market consumers have to follow a complex booking process – more than once at times – to fill their shopping basket. The latter in a context in which both the air fare and the prices of ancillary services vary dynamically over time. It is worth noting that the revenue that carriers derive from flight ancillary services (through an unbundled purchase) often represents a significant share of their total revenue (13 % on average).

Role of metasearch engines. Resorting to metasearch engines (such as Skyscanner and Google Flight) does not allow for an exhaustive comparison between the offers of the various carriers in terms of price, despite the fact that these tools simplify the search activity. As a matter of fact, the comparisons are made in relation to the basic fare option (default offer), without any indication of ancillary services or flexibility conditions. Metasearch engines do not allow users to select their unbundled fare option for the purpose of comparing the offers of different carriers.

Recent in-depth studies and regulatory interventions on transparency. Concerns regarding the transparency and comparability of prices of air transport services has, also recently, been the subject of in-depth studies at a European level and of regulatory interventions at a non-European level. At a European level, as part of the assessment of the effectiveness of Regulation 1008/2008, the European Commission has raised some issues regarding fare transparency, in particular with respect to the disclosure of fare options by carriers. Outside of Europe, the United States Department of Transportation recently issued a regulation aimed at improving the transparency of air fares with regard to the so-called "critical" ancillary services, i.e., carry-on baggage, first and second checked bag, changing or cancelling of a booking. The new regulation requires air carriers and ticketing agencies to disclose fees for "critical" ancillary services at the first point where a fare and flight schedule is provided (in connection with a specific flight itinerary).