

The Influence of the Open Sky on Airlines in Tunisia



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ABSTRACT: The importance of this research is to analyze the impact of open sky on transport air transport in Tunisia and determine the equilibrium price, quantities and profit of each airline by adopting Analysis of the effect of concluding an "Open Sky "between Tunisia and the European Union will be carried out according to 3 scenarios

- Scenario 1: Air France enters the Paris-Djerba and Tunis-Djerba circuit
- Scenario 2: Competition on the Paris-Tunis and Tunis-Djerba market
- Scenario 3: Collision between companies

1. INTRODUCTION

The approach that we will follow at this level of this article is a purely microeconomic approach; will be exposed simultaneously (i) the theoretical model underlying the study of airline behavior under various hypotheses relating to the introduction or not of Open Sky and (ii) the results of the microeconomic analysis.

2. REVIEW OF EMPIRICAL LITERATURE

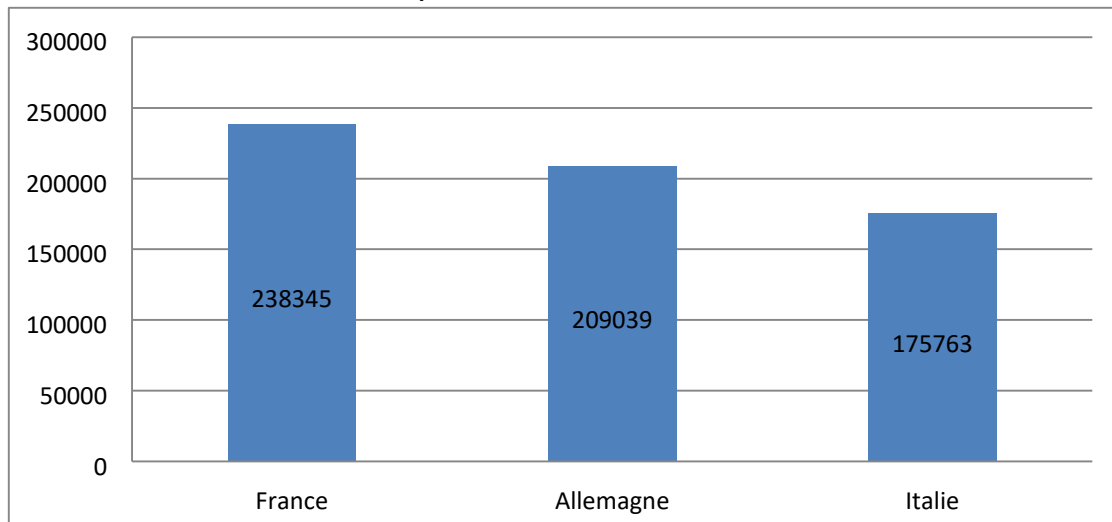
The determinants of air flow have been the subject of several studies (Goetz (1992); Ivy, Fik and Malecki (1995); Button et al. (1999); Debbage and Delk (2001); Brueckner (2003); Liu and al. (2006), Discazeaux and Polèse (2007); Al Kaabi and Debbage (2007), Dobruszkes (2009). Covering different periods and various types of cities, these analyzes confirm a strong correlation between air flows and the local economy. We note that the authors converge to retain various elements relating essentially to three families: the size of the urban agglomeration (via various variables), the structure of its economy and its geographical location. According to research, the influence of each of them these three families of determinants is variable. This could be seen as proof of their complementarity to better understand the determining factors that generate air traffic (Drobuzkes, 2009) Button et al. (1999), Debbage and Delle (2001), Brueckner (2003) and Liu et al. (2006), Al Kaabi and Debbage (2007) show that some employment sectors have a higher potential than others to generate air traffic. Indeed, "the growing dispersion of economic activities and the complex circuits of the contemporary economy have led to a concentration in the cities of the development of higher management and coordination functions" (Drobuzkes, 2009: 10). Although these activities concern only part of the economy of cities, they strongly contribute to their economic dynamism.

3. THE FOUNDATIONS OF THE THEORETICAL MODEL

Cournot's theoretical model proposed by Alves, Vera and Rosa Forte (2015). The authors analyze the case of an open skies agreement between Brazil and the European Union. This model can be adapted to the case of Tunisia with the European Union since Brazil and Tunisia frequent the same European market for the tourism sector and having the same characteristics in terms of the number of visitors, especially European ones. Thus, Brazil received 6,621,375 visitors in 2018 including 1,460,740 European visitors, Tunisia, over the same period received 6,920,188 tourists among them 1,317,029 European visitors

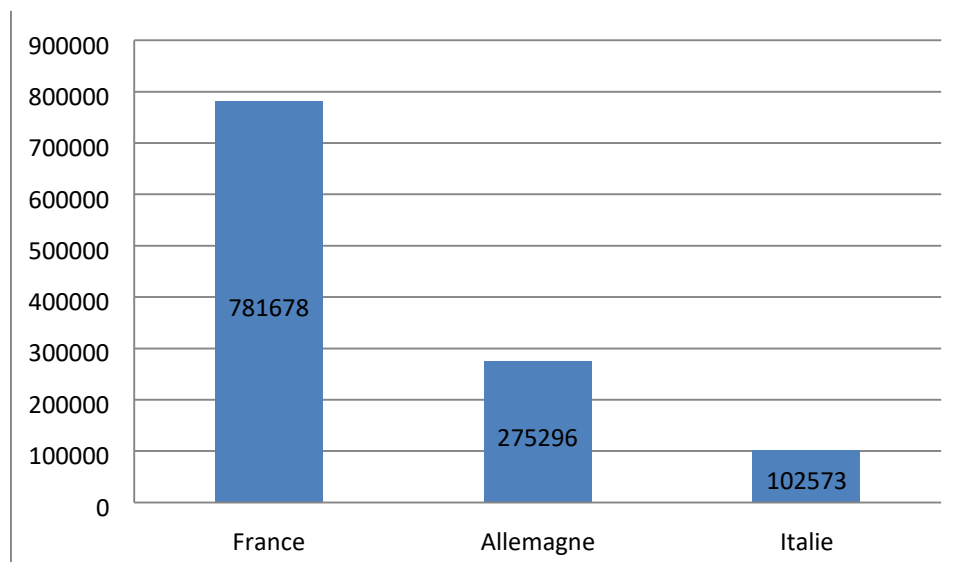
The Influence of the Open Sky on Airlines in Tunisia

Figure 1: Breakdown of entries from the main European countries to Brazil



Source: World Bank

Figure 2: Distribution of entries from the main European countries to Tunisia



Source: National Institute of Statistics

3.1. Cournot model for the analysis of the effects of the agreement

As mentioned earlier, in the case of open sky agreements, more airlines can operate the same destination and route. This part attempts to analyze whether the open sky agreement, which allows the entry of new airlines, would increase competition, reduce fares and therefore benefit consumers. In this sense, the scenarios are related to the entry of new airlines in certain market segments and to the establishment of a collusion between two airlines, one of which is the incumbent operator (Tunis air).

The profit of a business depends on the quantity produced and sold. But a company's profit also depends on the production and sale of its competitor: the more its competitor sells, the lower the market price and the lower its profits. There is an interdependence of benefits. Every business knows that if it can unilaterally increase its market share by producing more, its profits will increase.

However, every business also knows that if all businesses compete fiercely for more market share, they will all be doing well. Thus, lower prices will reduce overall and individual profits. The model we will follow is adopted by Alves and Forte (2015).

The model assumes constant marginal costs for each airline. The reverse demand function (price) of a given airline is defined as the function of traffic or passenger flow satisfied by competitors (Cournot competition). The adopted model represents

The Influence of the Open Sky on Airlines in Tunisia

the international market between the European Union and Tunisia and includes three market segments: Paris-Tunis, Tunis-Djerba and Paris-Djerba.

It is assumed that in this market, only three airlines operate: Air France, Tunisair and Nouvelair. Air France serves the Paris-Tunis segment while Tunisair and Nouvelair are present on the Tunis-Djerba route. Thus, none of the three airlines operates the entire Paris – Djerba route. In this scenario, a tourist who wishes to travel from Paris to Djerba must purchase two tickets, the first transporting him from Paris to Tunis and the second transporting him from Tunis to Djerba. The first segment of the route is a monopoly, the second part is a duopoly. In this initial diagram, three possible scenarios are presented.

In these scenarios one can adopt a system of the Taxi plane between the airports Djerba-Zarzis and Tunis-Carthage which are at a distance of 500 kilometers from each other. To make the transfer, a traveler can opt for a yellow taxi or they can book a private shuttle in advance. The price difference between a yellow taxi and a private transfer is negligible. On the other hand, if the travelers are numerous, the reservation of a transfer (by minivan or by train) costs less because the yellow taxis take only three people. By booking online, you can save time and you will have peace of mind.

3.2. Expected effects of the agreement

The analysis of the effect of the conclusion of an "Open Sky" agreement between Tunisia and the European Union will be carried out according to 3 scenarios:

- Scenario 1: Air France enters the Paris-Djerba and Tunis-Djerba circuit
- Scenario 2: Competition on the Paris-Tunis and Tunis –Djerba Market
- Scenario 3: Collision between companies

3.2.1.1. Analysis under scenario 1: Air France enters the Paris-Djerba and Tunis-Djerba circuit

In this first scenario, Air France enters the Paris-Djerba circuit, which allows it to be present in the three market segments (Paris-Tunis, Paris-Djerba and Tunis-Djerba), thus increasing competition in the segment. Tunis-Djerba.

By comparing the results of the initial situation and the results presented in this first scenario, the model suggests that prices on the Paris-Djerba and Tunis-Djerba routes should decrease. The effect on the Paris-Tunis segment is not clear, as it depends on several factors. Since the Paris-Tunis route does not have many substitutes, the price should increase, as the Open Sky agreement does not introduce additional competition, there is no pressure to reduce the price. . Once again, the Paris-Djerba segment should be cheaper as it is offered by several airlines in Europe.

This result is consistent with the conclusions of Cournot (1838), namely that in the case of two complementary products (Paris-Tunis and Tunis-Djerba routes) produced by a single company, the prices will be lower; This therefore benefits consumers of the entire journey.

Likewise, the European companies will realize profits greater than the sum of the Tunisair and Nouvelair profits with regard to the Tunis-Djerba route; the same companies will realize higher profits in quality as a result of the Open Sky agreement. Tunisair and Nouvelair will benefit from lower profits under the Open Sky agreement.

Passengers benefit from the open sky layout for the Paris-Djerba and Tunis-Djerba route segments. Taking into account the effects on tourism, this would necessarily increase the number of tourists who would go to Djerba, due to the fall in prices. On the other hand, passengers on the Paris-Tunis line will experience higher prices because the route remains monopolistic.

3.2.1.2. Analysis under scenario 2: Competition on the Tunis –Djerba and Paris -Tunis market

In this second scenario, Air-France enters the Tunis-Djerba market and Tunisair enters the Paris-Tunis market. As a result, competition on the Paris-Tunis market is increased compared to the first scenario, since the Paris-Tunis route is operated by two companies, while Nouvelair only operates the Tunis-Djerba route.

By comparing the expected results of the initial situation, in the second open sky scenario, prices in the three segments (Paris-Tunis, Tunis-Djerba and Paris-Djerba) would decrease, increasing the number of passengers and benefiting passengers on all markets.

With regard to the benefits of airlines, the effects of liberalization are not uniform. As Tunisair's results increase in this second scenario, Nouvelair is damaged by deregulation, which reduces its profits as the Tunis-Djerba segment shrinks. Air-France's entry into the Tunis-Djerba segment increases competition.

3.2.1.3. Analysis under hypothesis 3: Collusion between Air France and Tunis air

In the third scenario, Air France and Tunis air agree to operate Paris-Tunis flights by offering passengers Paris-Tunis and Tunis-Djerba connections as part of the collusion system.

The Influence of the Open Sky on Airlines in Tunisia

By comparing the results of the initial situation with this third scenario, the price of ParisDjerba decreases again and generates a greater flow of passengers.

The price in the Tunis-Djerba segment remains the same, as does the number of passengers. By analyzing the profits of airlines, we can conclude that after the Open Sky agreement, the profits of Air France and Tunisair would increase. This increase is expected since the objective of collusion is the joint maximization of the profits of the two companies.

Finally, traffic in the Paris-Tunis segment should increase or decrease as in the first scenario.

By comparing the expected results of the three scenarios, we observe that the second scenario is the one that benefits passengers the most due to the fall in prices in the three flight segments and is the one that would generate a greater flow of passengers and tourists. . However, this second scenario is also the one that generates the most incentives for airline collusion, as it is the third scenario that generates more profits for the airlines. The above results are summarized in the following table.

Board 1: Summary of expected results of the theoretical model

	Segment 1. CDG-TUN	Segment 2. TUN-DJE	Segment 3. CDG-DJE	Open sky results against the initial situation
Initial situation without open sky	An option : Air France (monopoly)	Two options: Tunis air or Nouvelair (duopoly)	Any Airline company	
First scenario Because of the Open Sky, Air France enters the full ParisDjerba route.	An option : Air France (monopoly)	Three options: Tunis-Djerba Paris- Tunis Paris - Djerba	An option : Air France	The price decreases in segments 2 and 3, more passengers due to increased competition. Air-France obtains more profits. Tunis Air and Nouvelair get less profit.
Second scenario Due to the open sky, Air France enters the Tunis - Djerba route and Tunis air enters the Paris- Tunis route.	Two options: Air France, Tunis air (duopoly)	Three options: Tunis air, Nouvelair, Air France	An option : Air France	More competition on the Paris-Tunis route. Lower prices in all three segments, so there will be more passengers. Tunisair gets more benefits. Due to deregulation, Nouvelair will make less profit. Air-France's profits will depend on the company's level of efficiency. This is the most advantageous scenario for passengers and the one that attracts the most tourists to Tunis. But it is also the one that generates the most incentives for collusion for airlines.

The Influence of the Open Sky on Airlines in Tunisia

<p>Third scenario: Air-France and Tunisair have agreed on quantities to operate the route Paris –Tunis.</p>	<p>Two options: Air France, Tunisair (duopoly)</p>	<p>Three options: Tunisair, Nouvelair, Air France.</p>	<p>Two options: Tunisair, Air France</p>	<p>No more competition on the Paris-Djerba route. Lower prices in all three segments, so there will be more passengers. Air France and Tunisair obtain more benefits. Nouvelair less profit.</p>
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Source: Author's summary

Airlines that do not have the capacity to compete will be negatively affected, their profits will decline, a claim that contradicts the effects expected in the literature. Part of this statement can be explained by the strategic behavior adopted by airlines, the restructuring of routes and networks, frequent flyer programs as well as the limited capacity of airports which can delineate the positive effects expected by governments at the time of the conclusion of this kind of Open Sky agreements.

3.3 Application of the Cournot model to airlines

We seek to study the effects of the Open Sky Agreement on airline prices and profits. Thus, we develop a theoretical model to compare the pre-agreement situation with three postagreement situations, using the Cournot model with three market segments and analyzing the case of an open skies agreement between the EU and Tunisia.

To the best of our knowledge, there is no model open skies agreement; we therefore base our model on two code-sharing models, developed by Bruckner (2001) and Bilotkach (2007). The major difference between the two situations is that in the case of open skies more companies can operate a given route, while in the case of codeshare the number is the same, but one airline operates. flights that may also be sold by another airline.

In the case of codeshare, there is no increased competition, but quantities can increase and prices decrease. It is in this aspect that the two situations are similar. Brueckner (2001) aims to understand the effects of a substitution code-sharing agreement while Bilotkach (2007) looks at complementary partnerships. In both studies, the authors use Cournot's model with several market segments:

- Brueckner (2001) presents a model with two firms operating in various market segments but competing in a single segment. The hypotheses tested by Brueckner (2001) relate to the establishment of a codeshare agreement between the two airlines while also taking into account the economies of scale resulting from this partnership.
- Bilotkach (2007) presents a model comprising only three market segments (one domestic and two international) and three airlines:
 - In the initial situation, company 1 is national and operates in market segments,
 - company 2 is also national but only operates domestic flights in the domestic segment,
 - while Company 3 is international and cannot operate flights on the domestic route.

Bilotkach (2007) aims to test the effects of code-sharing agreements (partnership between companies 2 and 3) and semi-complementary partnerships (partnerships between companies 1 and 2 or 1 and 3).

Using the same Cournot model, we seek to verify and analyze whether an "open skies" agreement allowing the penetration of new airlines into international markets and liberalizing competition would lead to lower prices and therefore benefit consumers. Thus, the hypotheses tested concern the entry of airlines into certain market segments and the establishment of collusion between two airlines.

For simplicity's sake, we assume constant marginal costs for each airline. In contrast, the inverse demand function (or price) of an airline is defined as a function of the traffic satisfied by its competitors (competition from Cournot).

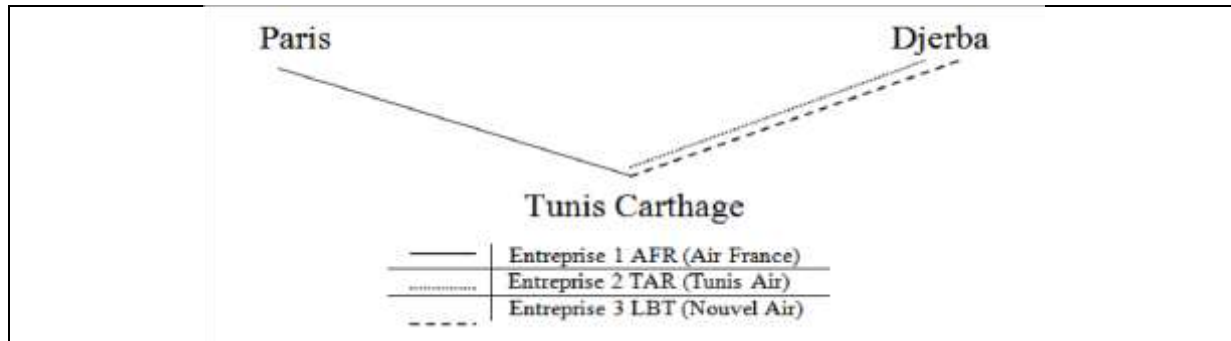
3.3.1. Baseline: No Open Sky agreement

In this analysis we study the international market between France and Tunisia, this market includes three segments: Paris - Tunis, Tunis - Djerba and Paris-Djerba. It is assumed that in this market only three airlines are operated, these are Air France, Tunis Air and Nouvel Air. At the start of the situation (Figure 21), company 1 was present in the market segment between Paris and Tunis (international link), while companies 2 and 3 provided the flight between Tunis and Djerba.

The Influence of the Open Sky on Airlines in Tunisia

We can therefore see that none of the airlines operates on the Paris-Djerba route. Thus, a passenger wishing to make a trip between Paris and Djerba would buy two tickets: Travel with a ticket from the Paris –Tunis market and change planes in Tunis Carthage. On the Tunis - Djerba market segment, the passenger can choose to travel with airline 2 or 3. Thus, in this scenario, the Paris-Djerba route is an interlining market.

Figure 3: Structure of the network before the implementation of the "open skies" agreement



Source: Author representation

3.3.1.1. Notations and Basic Assumptions

As we announced above, we have three companies Air France, Tunisair and Nouvelair which serve, although at different rates, the following routes: Paris-Tunis, Tunis –Djerba and Paris -Djerba. It is assumed that according to Cournot, adapted from Alves and Forte (2015), that airlines compete in quantity. In what will follow of the analysis we retain the following notations:

- *PD*: Paris - Djerba route
- *PT*: Paris -Tunis route.
- *TD*: Route Tunis - Djerba.
- *PPD*: Reverse demand function for the Paris to Djerba market segment.
- *PPT*: Reverse demand function for the Paris to Tunis market segment.
- *PTD*: Reverse demand function for the Tunis to Djerba market segment.
- *a*: The reserve price on the Paris - Tunis market.
- *b*: The reserve price on the Tunis – Djerba market
- *d*: The reserve price on the Paris-Djerba market.
- *c*: The marginal cost of a traveler.

3.3.1.2. The marginal cost of a traveler

For the marginal cost calculation, the following assumption is used: When adding 100 kg at the last moment (i.e. a passenger with luggage), approximately 40 kg of additional kerosene will be needed to transport these 100 kg on a long-haul flight more than 10 hours¹.

Under this assumption, and in accordance with the duration of the journey between the different destinations, the marginal cost of a traveler is described in the following table.

Board 2: Marginal cost per traveler

	Trip duration (in Hours)	Cost (In Tunisian Dinars)
TUNIS –PARIS	2: 21	65.80
TUNIS –DJERBA	0: 56	26.13
PARIS-DJERBA	2:46	77.46

Source: Our calculations

3.3.1.3. The reservation price

Reservation prices are defined in accordance with the minimum pricing for each destination, these prices are determined via a flight price comparator; the prices selected are described in the following table:

¹ [https://voyageforum.com/discussion/cout-vol-long-courier-compagnie-d3064692/.](https://voyageforum.com/discussion/cout-vol-long-courier-compagnie-d3064692/)

The Influence of the Open Sky on Airlines in Tunisia

Board 3: Reservation price

R	Reservation price (in Tunisian Dinars)	Route
AT	570	Paris-Tunis
B	51	Tunis - Djerba
D	486	Paris - Djerba

Source: Noscalculs

3.3.1.4. Balance in the absence of an Open Sky agreement

Still in the same vein, for the adaptation of Cournot's model we also retain the following notations for quantities, prices and profits on the different routes.

x = is the quantity requested for the Paris - Tunis trip. y = is the quantity requested for the Tunis -Djerba route. z = is the quantity requested for the Paris and Djerba journey.

π_1 = Air France benefits.

π_2 = Tunisair benefits.

π_3 = Nouvelair benefits.

The results from the derivation of the Cournot model are shown in the following table.

Board 4: Before liberalization, is the initial situation without open skies

Equilibrium price	Quantities (traffic)	Airline profits
$PPT = \frac{1}{12}(3a - b + 4c + 3d)$	$x = \frac{1}{12}(9a + b - 4c - 3d)$	$\pi_1 = \frac{1}{72}(3a - b - 8c + 3d)^2$
$PTD = \frac{1}{3}(b + 2c)$	$y = \frac{2}{3}(b - c)$	$\pi_2 = \frac{1}{9}(b - c)^2$
$PPD = \frac{1}{4}(a + b + 4c + d)$	$z = \frac{1}{4}(3d - a - b - 4c)$	$\pi_3 = \frac{1}{9}(b - c)^2$

Source: Our derivation from the work of d'Alves and Forte (2015)

Board 5: The results

Equilibrium price (In Tunisian Dinars)	Quantities (traffic)	Airline profits (In Tunisian Dinars)
$PPT = 281.68$ D	$x = 288.31$	$\pi_1 = 932,11^D$
$PTD = 34.42$ D	$y = 16.58$	$\pi_2 = 68,72^D$
$PPD = 354.21$ D	$z = 131.79$	$\pi_3 = 77,79^D$

Source: Noscalculs

3.3.2. Alternative situation: A Cournot model to analyze the effects of an open sky agreement

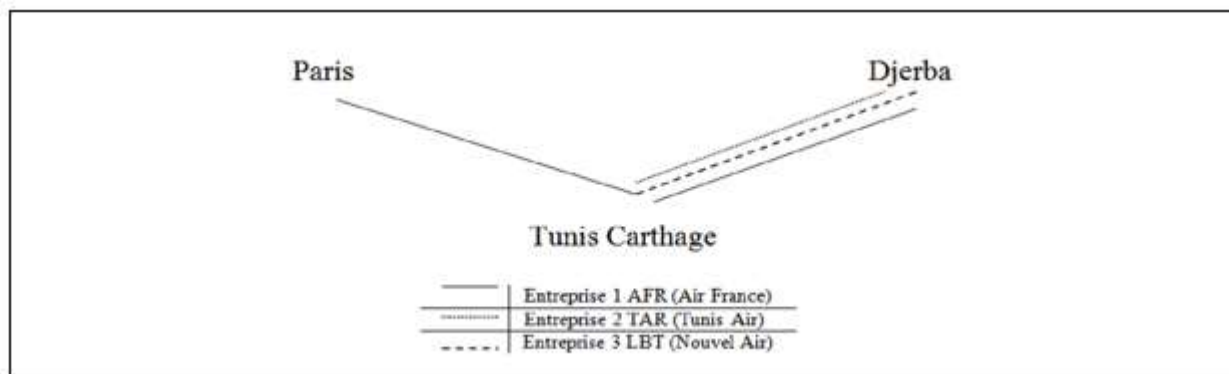
3.3.2.1. Hypotheses

We would like to remind you that the Paris -Tunis market is a monopoly market in which company 1 operates, while the Tunis - Djerba market is a duopoly market in which companies 2 and 3 operate. To understand the impact of the effects of an Open Skies agreement, we test three hypotheses:

- Hypothesis 1 (H1). Company 1 enters the Tunis - Djerba route, which allows it to be present in the three market segments (the international segments Paris-Tunis and Paris-Djerba and the domestic segment Tunis - Djerba). Thus, while company 1 is the only one to manage international flights (monopolies), market competition increases on the Tunis - Djerba market (figure 12).

The Influence of the Open Sky on Airlines in Tunisia

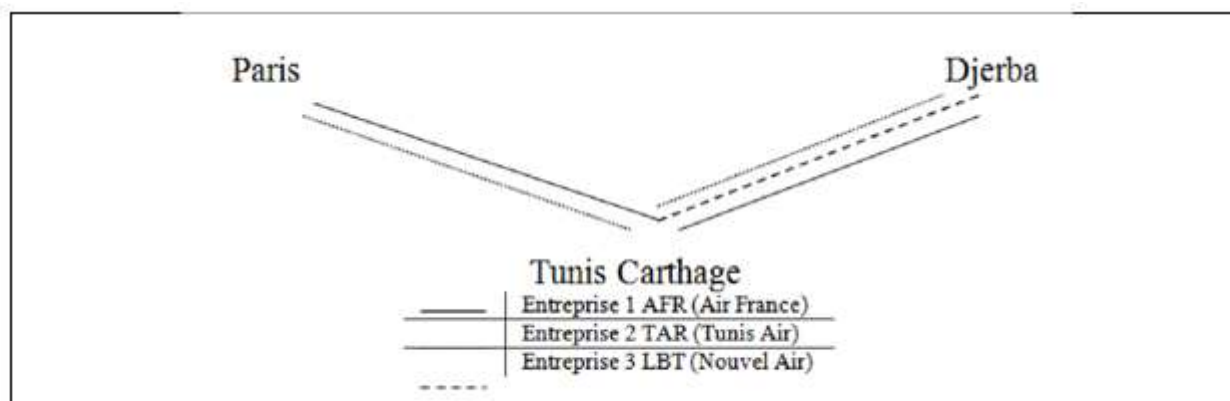
Figure 4: Structure of the network after the implementation of the "open skies" agreement, under H1



Source: Author representation

- Hypothesis 2 (H2). Company 1 enters the Tunis Carthage - Djerba market and company 2 enters the Paris - Tunis Carthage market. Thus, a certain competition is introduced on the Paris –Djerba market (compared to H1), this link being operated by companies 1 and 2. In addition, company 3 continues to operate flights only on the internal route, Tunis Carthage. and Djerba (see Figure 13).

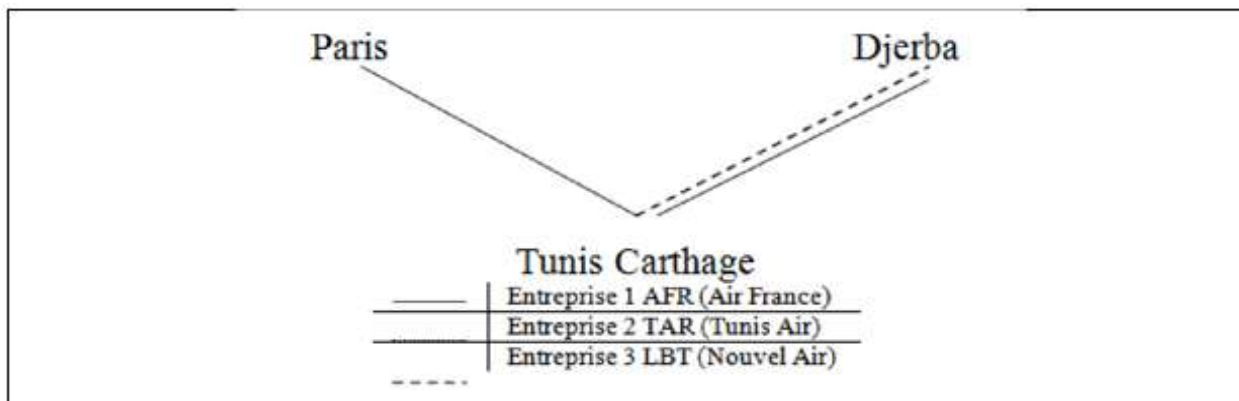
Figure 5: Structure of the network after the implementation of the "open skies" agreement under H2



Source: Author representation

- Hypothesis 3 (H3). Collusion between companies 1 and 2 in order to operate flights on the Paris - Tunis Carthage market, offering customers the two complementary services (Paris-Tunis Carthage and Tunis Carthage - Djerba connections). With collusion, the companies involved would have to decide together on the definition of the quantities to be supplied, so that these airlines would have to agree on the quantities in order to maximize the common profit (see figure 14).

Figure 6: structure of the network after the implementation of the "open skies" agreement, under H3



Source: Author representation

3.3.2.2. A return to the freedoms of the air

As we mentioned in chapter 2 with regard to air freedoms, it should be noted that "open skies" agreements generally apply in stages, including several "freedoms of the air", so there are some agreements that include more freedoms than others.

The Influence of the Open Sky on Airlines in Tunisia

According to ICAO (2004), “freedoms of the air” constitute a group of nine rights or privileges that may exist in an air transport market.

At present, typical Open Sky agreements do not provide for all freedoms of the air. However, it should be noted that the greatest freedom of air is the ninth. The “ninth freedom of the air is the right or privilege to carry cabotage traffic of the granting State on a service performed entirely within the territory of the granting State (also called “ ninth freedom right ”or“ autonomous cabotage ”. (ICAO, 2004).

In other words, with an open skies agreement between France and Tunisia, as part of this freedom, a French airline could transport traffic between two Tunisian cities, on a flight operated entirely by the French airline, as under H1 and H2. Typical “open skies” agreements do not allow this, but in the future, “open skies” agreements could evolve into broader agreements incorporating other freedoms of the air.

In this way, it is very important to study what might happen when the "open skies" agreements include the ninth freedom. Another hypothesis of the H2 is that a Tunisian airliner connects a Tunisian city (Tunis) to a French city (Paris). Unlike what happens with the ninth freedom, the atypical open skies agreement already includes this right. Finally, H3 is concerned about the possibility of collusion between two airlines after the implementation of an "open skies" agreement².

3.3.2.3. Balance with the establishment of an Open Sky agreement

From the above assumptions, we intend to understand the effects of an Open Sky agreement on prices, airline profits and also to investigate whether consumers will be favored by the implementation of the agreement.

Board 6: Balanced price and professional benefits in the four scenarios³

	Price	Quantities (Traffic)	Airline profits
Before liberalization	$p_{PT} = \frac{1}{12}(3a - b + 4c + 3d)$	$x = \frac{1}{12}(9a + b - 4c - 3d)$	$\pi_1 = \frac{1}{72}(3a - b - 8c + 3d)^2$
	$p_{TD} = \frac{1}{3}(b + 2c)$	$y = \frac{2}{3}(b - c)$	$\pi_2 = \frac{1}{9}(b - c)^2$
	$p_{PD} = \frac{1}{4}(a + b + 4c + d)$	$z = \frac{1}{4}(3d - a - b - 4c)$	$\pi_3 = \frac{1}{9}(b - c)^2$
Under H1	$p_{PT} = \frac{1}{2}(a + c)$	$x = \frac{1}{2}(a - c)$	$\pi_1 = \frac{1}{4}(a - c)^2 + \frac{1}{16}(b - c)^2 + \frac{1}{4}(d - c)^2$
	$p_{TD} = \frac{1}{4}(b + 3c)$	$y = \frac{3}{4}(b - c)$	$\pi_2 = \frac{1}{16}(b - c)^2$
	$p_{PD} = \frac{1}{2}(d + c)$	$z = \frac{1}{2}(d - c)$	$\pi_3 = \frac{1}{16}(b - c)^2$
Under H2	$p_{PT} = \frac{1}{3}(a + 2c)$	$x = \frac{2}{3}(a - c)$	$\pi_1 = \frac{1}{9}(a - c)^2 + \frac{1}{9}(d - c)^2 + \frac{1}{16}(b - c)^2$
	$p_{TD} = \frac{1}{4}(b + 3c)$	$y = \frac{3}{4}(b - c)$	$\pi_2 = \frac{1}{9}(a - c)^2 + \frac{1}{9}(d - c)^2 + \frac{1}{16}(b - c)^2$
	$p_{PD} = \frac{1}{3}(d + 2c)$	$z = \frac{2}{3}(d - c)$	$\pi_3 = \frac{1}{16}(b - c)^2$
Under H3	$p_{PT} = \frac{1}{2}(a + c)$	$x = \frac{1}{2}(a - c)$	$\pi_1 = \frac{1}{8}(a - c)^2 + \frac{1}{8}(d - c)^2 + \frac{1}{18}(b - c)^2$
	$p_{TD} = \frac{1}{3}(b + 2c)$	$y = \frac{2}{3}(b - c)$	$\pi_2 = \frac{1}{8}(a - c)^2 + \frac{1}{8}(d - c)^2 + \frac{1}{18}(b - c)^2$
	$p_{PD} = \frac{1}{2}(d + c)$	$z = \frac{1}{2}(d - c)$	$\pi_3 = \frac{1}{9}(b - c)^2$

Source: Our calculations

² With the Open sky there is the possibility of new airlines entering the markets, resulting in increased competition, airlines may be tempted to react with preemptive behavior, adjusting their prices or quantities in order to 'increase their profits or jeopardize others. So it seems very important to try to understand what can happen if a collusion occurs and if the airlines are made to become confused.

³ We also present in brackets the impact on the variables resulting from the implementation of the open skies agreement.

The Influence of the Open Sky on Airlines in Tunisia

Board 7: Result of the application of the Cournot model

Hypotheses	Price	Quantities (Traffic)	Airline profits
Before liberalization	$p_{PT} = 281,68$	$x = 288,31$	$\pi_1 = 932,11$
	$p_{TD} = 34,42$	$y = 16,58$	$\pi_2 = 68,72$
	$p_{PD} = 354,21$	$z = 131,79$	$\pi_3 = 77,79$
Under H1	$p_{PT} = 317,90$	$x = 252,10$	$\pi_1 = 1053,19$
	$p_{TD} = 32,37$	$y = 18,63$	$\pi_2 = 38,56$
	$p_{PD} = 281,73$	$z = 204,27$	$\pi_3 = 38,66$
Under H2	$p_{PT} = 233,866$	$x = 336,133$	$\pi_1 = 468,30$
	$p_{TD} = 32,347$	$y = 18,652$	$\pi_2 = 468,30$
	$p_{PD} = 213,64$	$z = 272,36$	$\pi_3 = 38,657$
Under H3	$p_{PT} = 317,9$	$x = 252,1$	$\pi_1 = 526,74$
	$p_{TD} = 34,42$	$y = 16,58$	$\pi_2 = 526,74$
	$p_{PD} = 281,73$	$z = 204,27$	$\pi_3 = 68,72$

Source: Our calculations

3.3.2.4. Effects of an open skies agreement

After the calculations made in the previous part, we get the results for the prices, quantities and profits of airlines for the baseline situation and under the three assumptions put forward above.

When comparing the results for the initial situation and those of the H1 hypothesis, we conclude that the prices on the Paris-Djerba () and Tunis-Djerba () routes should decrease. Thus, the entry of an international airline into the Tunis-Djerba (domestic) market and consequently on the Paris-Djerba line, i.e. increased competition on the Paris-Djerba and Tunis -Djerba routes, should lead to lower prices on these routes. $p_{PD} p_{TD}$ As the Paris-Tunis or Tunis -Djerba segments are short and include many substitutes (other means of transport to accomplish the same journey or stay), the price on the ParisTunis market may decrease after the open sky agreement. But, in this case, it is not likely, because the flight between Paris-Tunis does not have many substitutes, the price on the ParisTunis market should therefore increase.

Moreover, in this Paris-Tunis market segment, the “open sky” agreement does not introduce additional competition, there is no pressure to reduce the price. It should be noted that, as one might expect, the price of a trip between Paris and Djerba will be lower in the H1 hypothesis, given that the entire link (Paris-Djerba) is offered by the same airline.

This result is consistent with the conclusions of Cournot (1838), namely that in the case of two complementary products (route Paris-Tunis and Tunis -Djerba) offered by a single company, the prices will be lower and the quantities higher. This results from the process concerning the double margin in complementary products, ie when the internalization of two complementary services in the same company, the double margin ceases to exist, to the benefit of consumers. In this case, company 1 offers two additional services or one trip for the entire route.

The lower price for the Paris-Djerba (PD) market benefits consumers, which is also consistent with the conclusions of Cournot (1838). One of Cournot's main conclusions is that consumer surplus is greater when two complementary goods are produced by the same company. With regard to profits, the company which produces the two complementary goods will have profits greater than the sum of the profits of the two companies, when the complementary goods are produced by two different companies (Cournot, 1838)

By comparing the results of company profits, it can be concluded that the profit of company 1 should increase in hypothesis H1 compared to the situation without open sky agreement. However, the same is not true for the profits of companies 2 and 3, as they are expected to decline after company 1 enters the market (TD). This decrease will be due to increased competition and lower prices in this market segment.

We can draw two important conclusions about the effects of “open skies” agreements:

The Influence of the Open Sky on Airlines in Tunisia

- On the one hand, consumers should benefit from an "open skies" agreement. This is happening in the Tunis-Djerba and Paris-Djerba segments due to the drop in ticket prices in these markets. However, in the Paris-Tunis segment, which remains the monopoly of firm 1, prices may increase⁴.
- On the other hand, the number of passengers traveling in the Tunis-Djerba and Paris-Djerba segments is expected to increase under H1, which will also benefit consumers. On the Paris-Tunis market, the evolution of the number of passengers varies in the opposite direction to what happens on the price on this market: if this price increases, the number of passengers decreases and vice versa.

By comparing the results between the initial situation and the H2 hypothesis, we realize that prices in all three market segments fall (and traffic increases) after the implementation of an open skies agreement, thus benefiting consumers. from all markets. These results confirm the expected effects presented in the literature: increased competition on the Paris-Tunis market leads to a reduction in prices.

On the Paris-Djerba market, the fall in prices is due to the process of double margins of the complementary products mentioned above, to which must be added the fact that, under this assumption, there is competition on this market, competition which does not exist. did not exist before the "open skies" agreement. In the Tunis -Djerba market segment, despite the effect of complementary products, there are three airports in this market, so that this segment also experiences increased competition which will lead to lower prices.

With regard to airline profits, the effects of liberalizing the international market are not uniform: While the profit of company 2 increases (under hypothesis H2), company 3 is hampered by deregulation of the market and sees its profit decrease. As we know, the profit of company 3 depends on the Tunis -Djerba market price, which, for the reasons indicated above, is expected to decrease.

Finally, the profit of company 1 increases if this company is efficient and has low marginal costs compared to the reserve prices on the Paris-Djerba (a), Tunis-Djerba (b) and Paris-Djerba (d) markets. . This result is due to the trade-offs between the effect of complementarity (double marginalization) concerning company 1 and the effect of the existence of competition, company 2 also operating in this market. The effect of double marginalization exerts pressure on increasing the profitability of firm 1, but the existence of competition should introduce a reduction in the profit of that firm.

By comparing the results of the initial situation with the results of hypothesis H3, it can be concluded that the price of the Paris-Djerba market segment has fallen again. In addition, the price on the Tunis -Djerba market segment is identical (this market is a duopoly in both scenarios), while the effect on the price of the Paris-Tunis segment is not clear. In the case of the Paris-Djerba market, the price drop is linked to the fact that consumers will pay a single price.

Originally, without the "open skies" agreement, company 1 competes with companies 2 and 3, the services are not complementary (Paris-Tunis and Tunis -Djerba) and therefore experiences a double marginalization. But the liberalization of the international market leads to the internalization of two complementary services in the "same company" which leads to lower prices and benefits for consumers. It should be noted that the literature does not mention this fact. So this is a new result in this article.

With regard to the Paris-Tunis market, the evolution of prices between the base situation and the scenario presented by the H3 hypothesis is exactly the same as that of the H1 hypotheses mentioned above.

Depending on price trends, traffic under the H3 segment of the Paris-Djerba segment is expected to increase, which would benefit consumers in this market. The traffic on the Tunis -Djerba segment is identical to the H3 and before liberalization. Finally, the traffic in the Paris-Tunis segment could decrease or increase: the effect is similar to that of H1.

Analyzing the results of airline profits leads to the conclusion that in this case, after market liberalization, the profits of companies 1 and 2 increase. This increase was expected since the objective of collusion is to maximize the common profits of companies, but also adds the effect of eliminating incomplete double-marginalized products, which allows an increase in the profits of both companies. aerial. Finally, the profit of firm 3 is identical under H3 and before the "open sky" agreement, because of the price distortions of the Tunis -Djerba segment introduced by the collusion between firms 1 and 2.

⁴ Prices may increase if the company does not control its marginal cost (c) and if the reserve prices on the Paris - Tunis and Tunis - Djerba markets do not decrease.

The Influence of the Open Sky on Airlines in Tunisia

By comparing the three hypotheses retained (H1, H2 and H3), we can conclude that hypothesis H2 is the one that benefits passengers the most, due to the fall in prices in the 3 segments and the increase in the number of passengers. Moreover, it appears that an "open skies" agreement under H2 increases similar collusion since the profits of all airlines are higher under H3 than under H2. In this way, the implementation of an "open skies" agreement should be subject to appropriate monitoring in order to avoid any collusion between companies.

In summary, thanks to the model developed and the hypotheses examined, it was found that, as predicted in the literature, the prices of the Paris-Tunis and Paris-Djerba (international links) connections should decrease, which will therefore benefit consumers of these markets, especially when liberalization increases competition in the market, as has been analyzed in Hypothesis 2. With regard to airlines, although the trend seems to be an increase in profits for those able to penetrate on new routes after the agreement, airlines that do not have the ability to compete for new routes will be affected, their profits diminishing, contradicting the effects expected in the literature.

CONCLUSION

Throughout this article a study of the impact of Open Sky on company profits has been ensured; an impact on the price and on the number of passengers was also carried out. The theoretical framework adopted fits into the framework of strategic games between airlines; thus an adaptation of Cournot's model was developed. 3 hypotheses have been retained in relation to a reference situation considered to be a situation without open sky or 3 companies are called upon to compete on 3 markets.

We conclude that after the implementation of an "open skies" agreement, prices have fallen on international routes where competition is increasing, which will therefore benefit consumers. This fall in prices and the increase in consumer surplus are in line with those expected by the literature and are also due to the effect of double marginalization.

- In hypothesis H1 (entry of company 1 on the Tunis -Djerba market), consumers benefit from the drop in prices on the Tunis-Djerba and Paris-Djerba segments. However, in the Paris-Tunis segment, prices may increase because this market segment remains a monopoly of the company 1.
- Under hypothesis H2 (entry of company 1 on the Tunis-Djerba market and entry of company 2 on the Paris-Tunis market, As expected, an "open sky" agreement will lead to a drop in prices on all markets, which will benefit consumers on all routes.
- In hypothesis H3 (collusion between companies 1 and 2), the liberalization of an international market tends to benefit consumers of the international Paris-Djerba route because of the drop in ticket prices on this market.

With regard to airline profits, the results obtained show a trend towards an increase in profits for airlines using new routes after the agreement. However, airlines that are unable to compete for new routes after the liberalization of an international market are likely to suffer as their profits decline:

- In hypothesis H1, the net result (which operates more routes after the agreement) increases, but the reverse occurs with companies 2 and 3. Therefore, if there is a time lag for the new ones Airlines to operate all routes in the market, while others do, companies that cannot compete on new routes will be negatively affected, seeing their profits decline. The same is true if there is a temporal inequality between the airlines which design and implement their strategies.
- In hypothesis H2, an "open skies" agreement results in an increase in the profits of company 2. However, the liberalization of the international market results in a decrease in the profits of company 3, which may increase or decrease. This result for the profit of firm 1 is due to the trade-off between the effect of complementarity (double marginalization) and the effect of the existence of competition, with firm 2 also operating in this market. Thus, if the effect of double marginalization is greater than the effect of the existence of competition, the profit of firm 1 increases.
- In hypothesis H3, the profits of companies 1 and 2 increase after the liberalization of the international market and the profits of company 3 do not change. Therefore, the implementation of an open skies agreement may increase the risk of collusion and should be accompanied by measures to ensure competition.

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