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Cost Benchmarking Long Distance Train vs. Aircraft

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Train tickets should not be more expensive than airline tickets

Christoph Brützel

Abstract:

In today's political and media discussion there is an argument that airline tickets should not be cheaper than train tickets as this would foster growth of air traffic hurting the global climate by being the most negative means of transportation with regard to CO₂- and other greenhouse gas emissions. Therefore, rail transportation should be subsidized even more, and value added taxes should be reduced so that train tickets might become cheaper to dry out demand for air transportation and by this reduce traffic and its environmental impact. A cost benchmarking of a seat offered in a long-distance train at the example of a GERMAN ICE-2 and an Airbus A320, each operated on the route between Düsseldorf and Berlin shows, that this rationale is based on alternative facts.

Keywords:

Aviation, Airlines, Rail Companies, Long Distance Train, Cost Benchmarking, Short haul Flights, Modal Cost Rail Traffic, Modal Cost Air Traffic



The populist slogan that air tickets are cheaper than train tickets does not stand up to serious scrutiny¹. Even today, a train ticket on comparable routes is on average much cheaper than an air ticket. With regard to the cheap tickets of the airlines, which are always in the focus of attention, it can be stated that these are by no means meaningful for a representative comparison. In terms of revenue management, airline tickets are often offered at significantly lower prices than the average total cost of the seat provided. In individual cases, tickets are even sold below marginal costs for advertising purposes, like the following cost comparison between the circulation of an Airbus A320-200 and an ICE 2 on the Düsseldorf-Berlin-Düsseldorf route shows.

Cost comparison A320 / ICE 2

The following assumptions were made for this cost comparison between a round trip of an A320 and an ICE 2 between Düsseldorf and Berlin:

Aircraft / Train	A320-200	E-Tfz - DB 402 + DB 402 (ICE 2)
Initial Invest (Mil. euros)	30.0	36.6
Lifetime	25	25
No. od seats aircraft ²⁾ / train ³⁾	186 Y i.e. Easyjet)	808 1. cl. 212 2. cl. 550 bistro 46
Seat load factor	80 %	
Block time / operating hours round trip DUS-BER	02:30h	09:28h
Turnaround time TXL Stops at intermediate stations	0:50h	3:00'
Annual block hours / operating hours	3.000	3.000
Weighted Average Cost of Capital (WACC) ⁴⁾ 5)	4,2%	4,8%
Crew	2 Cockp., 4 Cab.	1Cockp., 6 Cab.
Employment cost Crew per hour	500 €	400 €
Kerosine per ton (airline) ⁶⁾ Power supply per kWh (Deutsche Bahn AG) ⁷⁾	558 €	0,0669 €
CO2-Certificate price per ton (airline) ⁸⁾ Energy taxes (9,6 %) of price per kWh (rail) ⁹⁾	29,50 €	0,0064 €

¹ Schober, A. e.a. (2018)

² Eiselin, S. (2015)

³ https://de.wikipedia.org/wiki/ICE_4

⁴ (Lufthansa (2018) [lufthansagroup.com/fileadmin/downloads/de/finanzberichte/geschaeftsberichte/LH-GB-2018-d.pdf](https://lufthansa.com/fileadmin/downloads/de/finanzberichte/geschaeftsberichte/LH-GB-2018-d.pdf)

⁵ Deutsche Bahn AG (2019a)

⁶ IATA (2019)

⁷ Deutsche Bahn Netze (2018)

⁸ finanzen.net (2019)

⁹ Deutsche Bahn Fernverkehr (2018)

For the ICE journey, intermediate stops at the stations Duisburg, Essen, Dortmund, Hamm, Hanover and Wolfsburg were planned. This increases the travel time accordingly. For the crews of the Airbus, the statutory minimum crew employment costs at the lower market limit were assumed.

Additional rail passengers do not incur any costs - every air passenger does.

The most striking difference is in passenger-related costs. As soon as a ticket generates more revenue than these passenger-related costs, it contributes to the overall profitability. While there are practically no additional costs for rail travel if an additional customer travels - at most the incremental energy consumption for the extra weight - the passenger-related costs for flights are often more than the revenue for a bargain ticket.

Cost Assessment ICE 2 Düsseldorf –Berlin – Düsseldorf (1)

Passenger-related Costs	per each passenger	per each round trip
Total	0,12 €	49 €
1. Taxes and public charges (without VAT)	- €	- €
2. Railway station fee (infrastructure) passenger-related	- €	- €
3. Cost of marginal electric power kW p.p. (100kg)	0,12 €	49 €

Cost Assessment A320-200 DUS – TXL – DUS (1)

Passenger-related Costs	per each passenger	per each round trip
Total	61,33 €	11.039 €
1. Taxes and public charges (without VAT)		
Passenger tax (LuftVStG vom 9.12.2010) ¹⁰⁾	14,76 €	2.657 €
Passenger security check DUS ¹¹⁾	5,21 €	938 €
Passenger security check TXL ¹¹⁾	7,55 €	1.359 €
Security charge p.p DUS ¹²⁾	0,88 €	158 €
Security charge p.p. TXL ¹²⁾	0,63 €	113 €
Total	29,03 €	5.225 €
2. Airport charges (Infrastructure)		
Passenger landing fee DUS ¹³⁾	14,98 €	2.696 €
PRM charge DUS (handicapped) ¹³⁾	0,58 €	104 €
CUTE charge DUS (IT infrastructure) ¹³⁾	0,28 €	50 €
Airport charges DUS p.p. total	15,84 €	2.850 €
Passenger landing fee TXL ¹⁴⁾	12,82 €	2.308 €
PRM charge TXL (handicapped) ¹⁴⁾	0,29 €	52 €
BRS charge (baggage infrastructure) ¹⁴⁾	0,05 €	9 €
Airport charges TXL p.p. total	13,16 €	2.369 €
3. Marginal Kerosene burn p.p. (100 kg) (3,7 % of add. Weight per each block hour)	3,30 €	595 €

The numbers tell that if the railway company would sell a return ticket for otherwise empty seats for just one Euro (including VAT), its profit would increase by 0.72 Euros (1,00 euro - 0,16 euro VAT - 0,12 euro marginal

¹⁰⁾ Luftverkehrssteuergesetz (2010)

¹¹⁾ Luftsicherheitsgebühr (2019)

¹²⁾ Düsseldorf Airport (2019)

¹³⁾ ibidem

¹⁴⁾ Flughafen Berlin Brandenburg (2018)

costs). Airlines, on the other hand, have to charge at least 73 Euros (including VAT) to cover passenger-related costs only.

Easyjet offers a price of 50.06 Euros including VAT for a return flight ticket to Berlin for the first week of September in August 2019. However, this price on balance will lead to a loss of profit and even cash flow. Easyjet pays almost 20 Euros more for taxes (excluding VAT), fees, charges and incremental kerosene consumption than the cash register.

Fare quotation DUS-TXL-DUS Easyjet

The screenshot shows the EasyJet website interface. At the top, there's a search bar and a 'Fortfahren' button. Below, it displays flight options for a round trip from Düsseldorf (DUS) to Berlin-Tegel (TXL) and back. The 'Warenkorb' (Shopping Cart) section shows a total price of 50,06 € for a round trip. The 'Tarifvergleich' (Price Comparison) table lists various services and their costs, including taxes, fees, and charges.

Source: www.easyjet.com (13.08.2019)

A glance at a comparable offer from Eurowings confirms this calculation. There, passenger-dependent taxes and charges of 58.16 euros are shown for one round trip DUS-TXL-DUS. If the incremental fuel consumption is added, the result is a value of 61.46 euros, which corresponds almost exactly to the value in the above calculation.

Fare quotation DUS-TXL-DUS Eurowings

The screenshot shows the Eurowings website interface. It displays flight options for a round trip from Düsseldorf (DUS) to Berlin-Tegel (TXL) and back. The 'Hinflug' (Outbound) and 'Rückflug' (Return) sections show flight details and prices. The 'Zusammenfassung' (Summary) table lists various services and their costs, including taxes, fees, and charges.

Source: www.eurowings.com (13.08.2019)

ICE seat costs two-thirds less than A320 seat

The variable **trip related costs** per seat of an ICE journey are significantly lower than that of an A320 flight, too, like the following list of the example round trip between Berlin and Düsseldorf clearly shows.

Cost Assessment A320-200 DUS – TXL – DUS (2)

Trip related costs	per each passenger	per each round trip
Total	57,34 €	8.257 €
1. Airport charges		
Aircraft landing charges DUS ¹⁵⁾	2,40 €	346 €
Gate_position charge DUS ¹⁵⁾	0,30 €	42,50 €
Noise surcharge (06:00h - 21.59h) DUS ¹⁵⁾	0,65 €	94 €
NO _x -charge DUS ¹⁵⁾	0,24 €	34 €
Aerodrome control charge DUS ¹⁶⁾	1,18 €	170 €
DUS airport charges total	4,76 €	686 €
Aircraft landing charges TXL ¹⁷⁾	1,08 €	156 €
Gate_position charge TXL ¹⁷⁾	0,37 €	53 €
Noise surcharge TXL ¹⁷⁾	1,74 €	250 €
Aerodrome control charge TXL ¹⁶⁾	1,18 €	170 €
TXL airport charges total	4,37 €	629 €
2. Ground Handling		
DUS Groundhandling¹⁸⁾	5,90 €	850 €
TXL Groundhandling¹⁸⁾	5,90 €	850 €
3. Area / en route control¹⁹⁾	4,99 €	718 €
3. Kerosene burn (without payload)	19,17 €	2.760 €
4. Emission certificates ETS	3,56 €	513 €
5. Crew travel costs	0	- €
6. Variable maintenance costs	8,68 €	1.250 €

In contrast to aviation, which funds its infrastructure (airports and air traffic control) completely at full cost by fees and charges, rail fees are not cost-covering. The state subsidizes the operation, construction and maintenance of rail infrastructure in Germany to the tune of over twelve billion euros annually²⁰.

¹⁵ Düsseldorf Airport (2019)

¹⁶ DFS Deutsche Flugsicherung (2019)

¹⁷ Flughafen Berlin Brandenburg (2018)

¹⁸ Ground Handling costs are subject to contractual agreement between airline and ground handling agent. Published quotation for services based on IATA Standard Ground Handling Agreement is about 1.500 Euros at DUS and TXL airport. Contractual quotation considered in the cost comparison is based on author's experience.

¹⁹ Eurocontrol (2019)

²⁰ Bundesnetzagentur (2018) and Bruetzel, C. (2019a)

Cost Assessment ICE 2 Düsseldorf –Berlin – Düsseldorf (2)

Trip related costs	per each passenger	per each round trip
Total	18,63 €	12.042 €
1. Railway station charges		
Station charge Düsseldorf Main Station ²¹⁾	0,06 €	39 €
Station charge Düsseldorf Main Station ²¹⁾	0,07 €	48 €
2. Rail track charges Düsseldorf-Berlin vv.²²⁾	17,09 €	11.046 €
3. Electric power train	1,41 €	910 €

The costs for the trip or flight are incurred when - and only when - a trip or flight is performed. They are incurred regardless of whether it is an empty trip or whether all passenger seats are occupied.

To cover these costs, the occupancy rate of the seat load factor is decisive. If only one passenger travels, including passenger-related costs he would have to cover 12,091 euros (excluding VAT) for the ICE journey, and around 8,150 euros for the A320. If, however, the aircraft and ICE are each filled at 80 percent, these marginal costs amount to 18,75 euros per passenger for rail travel but more than six times as much for flight (118,67 euros).

Airlines need significantly higher load factors

However, while for an airline such as Easyjet, Ryanair or Eurowings an average load factor of 80 per cent is well below the break-even point, in long-haul transport Deutsche Bahn Fernverkehr even makes a profit with an average load factor of 56 per cent. At this load factor, however, the cost per passenger is 26.78 euros, which is included in the railway's fare calculations.

In a cost comparison, the same seat load factor is to be assumed for both offers, since it is not the marketing and sales competence that is to be compared, but the cost structures. Since the travel and flight-related costs are incurred regardless of how many seats are occupied or not, it makes sense to evaluate them per seat rather than per passenger when comparing costs. For each seat in the ICE 2, this comparison results in 14.88 euros, for the Airbus A320 45.20 euros.

The **capacity-related fixed costs** of the train per seat in an ICE 2 are also significantly lower than those of an airline for an Airbus A320. These capacity-related fixed costs mainly arise from the provision of the vehicles or aircraft including their maintenance as well as from the personnel required to operate them, i.e. the crews.

For the vehicles, the values shown at the beginning of the premises were assumed based on published sources²³. The carrying amount of the A320's acquisition cost is far below the list prices published by Airbus, but corresponds to a realistic estimate taking into account the discounts granted regularly by the manufacturers.

When assessing cost of capital employed, the interest rates for the weighted average cost of capital (WACC) published by Deutsche Bahn and the Lufthansa Group in their respective reporting systems were applied, which indicate the minimum return the shareholders and creditors expect from the company. Remarkably, this interest rate is higher for the public utility Deutsche Bahn AG than for the privately owned Lufthansa group. Since the railway, as a company owned by the federal government, should not receive worse conditions for debt financing than Lufthansa (currently well below four per cent), the federal government's expectations of a return to the

²¹ Deutsche Bahn AG (2019b)

²² Deutsche Bahn AG (2019c)

²³ Statista (2019)

railway obviously are higher than those of Lufthansa shareholders. To put it mildly, this turns the current capital market theory on its head.

The imputed depreciation and interest were calculated as annuities over the entire useful life (25 years) on the basis of the acquisition costs and a residual value of zero euros and interest at the WACC.

For Airbus crews, the statutory minimum crew at employee costs at the lower end of the market was assumed corresponding to the author's experience. In addition to the driver, one manager and two other members of the driving staff were assigned to each part of the train. The service personnel, for example in the bistro, was not included in the train journey, as the costs caused by it systematically is to be funded by the corresponding prices for the service.

Cost Assessment ICE 2 Düsseldorf –Berlin – Düsseldorf (3)

Capacity-related costs	per each passenger	per each round trip
Total	24,29 €	15.701 €
1) Employment costs crew	7,32 €	4.733 €
2) Maintenance, repair, and overhaul costs	4,54 €	2.936 €
3) Depreciation and interest costs	12,42 €	8.031 €

Cost Assessment A320-200 DUS – TXL – DUS (3)

Capacity-related costs	per each passenger	per each round trip
Total	31,63 €	4.554 €
1 Depreciation and interest costs	11,35 €	1.634 €
2. Employment costs crew	11,60 €	1.670 €
3. Maintenance, repair, and overhaul costs (without trip-related)	6,94 €	1.000 €
4. Insurance costs	1,74 €	250 €

The **capacity-related costs** also show that Deutsche Bahn can produce a seat in the ICE much cheaper than an airline can produce a seat in the Airbus A320. However, the difference here is much smaller, probably also because the railways are not systematically subsidized with taxpayers' money in these cost items, while the costs of the rail track and station costs are largely financed from public budgets.

If the total variable and fixed operating costs of the ICE journey and the Airbus flight are combined, it can be seen that the train round trip costs less than one third of the flight at 80 percent capacity utilization per seat. In terms of capacity, Deutsche Bahn with a double ICE 2 train produces more than four times as many seats (4.34) as the airline, but has only 18 percent higher costs:

Total Operating Costs ICE 2 versus A320 DUS-BER-DUS

	ICE 2	A320-200	ICE 2 vs. A 320
Costs per each round trip (80 % SLF)	27.820 €	23.730 €	17,2%
Costs per each passenger (80% SLF)	43,04 €	150,29 €	-71,4%
Costs per each seat (80 % SLF)	34,43 €	120,24 €	-71,4%
Costs per each passenger full (100 % SLF)	34,43 €	131,83 €	-73,9%

The ICE column shows that due to the very low passenger-related costs per seat, slightly more than 34 euros are incurred for the round trip, i.e. 17 euros per segment. If all seats are occupied, the airline costs per seat are four

times as high as those of the train. In general, the fully allocated operating cost per each passenger of Deutsche Bahn make up less than 30 percent of that of an airline passenger.

In addition to operational travel costs, operating costs and administrative costs are also incurred in the central office, which also need to be covered if the company is to generate profits. If these are also taken into account, the following overall calculation is made:

Break-even Assessment ICE 2 Düsseldorf –Berlin – Düsseldorf

Assessment of break-even at fully allocated costs	per each passenger	per each roundtrip	Percent
Net Revenue (net of external distribution costs)	61,65 €	39.851 €	119,0%
- VAT	- 9,84 €	- 6.363 €	-19,0%
Net Revenue (net of VAT)	51,81 €	33.488 €	100,0%
- Passenger-related costs	- 0,12 €	- 77 €	-0,2%
= Contribution Ia (contribution of additional passenger)	51,69 €	33.410 €	99,8%
- Trip-related costs	- 18,63 €	- 12.042 €	-36,0%
= Contribution II (contribution of additional round trip)	33,06 €	21.368 €	63,8%
- Indirect operating costs (fixed)	- 24,29 €	- 15.701 €	-46,9%
= Contribution II (route contribution)	8,77 €	5.668 €	16,9%
- Indirect product overhead costs passenger	- 6,30 €	- 4.072 €	-12,2%
= Contribution III (Traffic Contribution)²⁴	2,47 €	1.596 €	4,8%
- Central Overhead costs (5% of costs at CL III)	- 2,47 €	- 1.596 €	-4,8%
= Profit/Loss including Cost of Capital employed at WACC	0,00 €	0 €	0,0%

Break-even Assessment A320-200 DUS – TXL – DUS

Assessment of break-even at fully allocated costs	per each passenger	per each roundtrip	Percent
Net Revenue (net of external distribution costs)	187,79 €	27.042 €	119,0%
- VAT	- 29,98 €	- 4.318 €	-19,0%
Net Revenue (net of VAT)	157,81 €	22.724 €	100,0%
- Passenger-related costs	- 61,33 €	- 8.831 €	-38,9%
= Contribution Ia (contribution of additional passenger)	96,48 €	13.893 €	61,1%
- Flight-related costs	- 57,34 €	- 8.257 €	-36,3%
= Contribution II (contribution of additional round trip)	39,14 €	5.636 €	24,8%
- Indirect operating costs (fixed)	- 31,63 €	- 4.554 €	-20,0%
= Contribution II (route contribution)	7,51 €	1.082 €	4,8%
- Product Overhead Costs (4 % of cost at CLII)	- 4,51 €	- 649 €	-2,9%
= Contribution III (Traffic Contribution)	3,00 €	433 €	1,9%
- Central Overhead costs (2% of costs at CL III)	- 3,00 €	- 433 €	-1,9%
= Profit/Loss including Cost of Capital employed at WACC	0,00 €	0 €	0,0%

²⁴ »Other Expenditures« as stated in Deutsche Bahn Fernverkehr (2018)

If, for example, with an ICE load factor of 80 percent, Deutsche Bahn achieves an average ticket revenue of 61.65 euros for a return ticket from Düsseldorf to Berlin including VAT, this fare covers all attributable company costs including the earnings expectations of the federal government as shareholder. An airline, on the other hand, has to charge an average of three times as much from its guests to break even.

Rail tickets could be significantly cheaper

Even if the cost estimates presented here are in some details, especially in the area of fixed costs, are well-founded estimates only, and in reality may result in slightly different values for Deutsche Bahn or Easyjet, the dimension of the difference allows a clear conclusion to be drawn:

The assertion that the costs of Deutsch Bahn Fernverkehr would have to be subsidized more heavily or that VAT would have to be reduced so that the company could offer more attractive prices may seem helpful to rail lobbyists, but in fact it belongs in the realm of alternative truths. Incidentally, the statement that on balance flights are subsidized more than the railways is simply wrong.

The scope of optimization of the railways to offer more attractive prices in the sense of profit-increasing capacity utilization certainly is greater than that of the airlines, as the comparison between the circulation of an Airbus A320 on the DUS-TXL route and the circulation of an ICE 2 on the Düsseldorf Main Station - Berlin Main Station route could not have shown more clearly.

In long-distance traffic, Deutsche Bahn Fernverkehr achieves considerable profits with an average seat load factor of 56 percent²⁵. This includes guests who do not get a seat at all in overcrowded trains, so that rail cars actually operate through the country with an average of half the seats empty.

In conclusion, Deutsche Bahn Fernverkehr does not have the problem of having to offer more capacity or operate more frequently. When the trains are full, there are no bargain prices for flights either. If, however, the airlines try to fill their empty seats with cheap ticket offerings, then Deutsche Bahn might market its empty seats at prices even far below the "super savings prices" of 19.90 euros, and still generate more profit.

Airlines do not have this option. Thanks to liberalization and competition actively fired by the European Commission, the downward price spiral is regularly overturned here, so that neither Eurowings nor Easyjet can currently achieve profits on the Düsseldorf-Berlin example route.

²⁵ Deutsche Bahn Fernverkehr (2018).

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