Reducing harm from aircraft noise: an analysis of the economic and safety effects of the operation of Brisbane Airport

Submission to Senate Rural and Regional Affairs and Transport References Committee

Inquiry into the impact and mitigation of aircraft noise

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Findings

* The economic losses associated with dis-amenity from aircraft noise in Brisbane are substantial, and at the margin, exceed the benefits of additional capacity at the airport

* A large body of international literature shows that the disamenity of aircraft noise is capitalized into land values. Based on international estimates, each additional dB of noise reduces land values by between 0.5 and 0.9 per cent

* For an impact of 10 decibels, the implied reduction in property vales ranges from $4–7 billion. This may be compared to the cost of constructing the second runway, estimated in the range $1.1-1.3 billion. For a discount rate of 7 per cent and a noise increase of 10db, the implied annual disamenity ranges from $300 million to $500 million, equal to between $1800 and $3000 per person in the affected area, and between $15 and $25 per passenger using the airport.

* In denying the significance of these effects, Brisbane Airport Corporation relies on low-quality unreviewed consultant reports which contradict the findings of a large body of Australian and international research

* The additional consumer welfare associated with a 10 per cent increase in flights to and from Brisbane Airport is of the order of $10 million per year

* The social costs of late-night international departures exceed the convenience benefits to airlines and passengers by a ratio of around 1000 to 1.

* Projections of massive growth in passenger numbers, making the second runway an unavoidable necessity were clearly over-optimistic even before the Covid 19 pandemic. There has been essentially zero growth in passenger numbers since 2012-13, rendering the economic case for the second runway largely invalid. The BAC projection of 50 million passengers by 2035 is unrealistic and undesirable.

* Aircraft noise is a major public health problem, contributing to a substantial increase in the risk of heart attacks, including fatalities, in areas with high noise exposure, as well as many other adverse effects

* The International Civil Aviation Organisation and the Civil Aviation Safety Authority pay little or no attention to these predictable health and mortality effecs, focusing instead on tiny reductions in the already minuscule risk of airline crashes.

Recommendations

* Brisbane Airport should be subject to a curfew from 10pm to 6am

* Air travel to and from Brisbane airport should be subject to a charge representing the costs of aircraft noise. The proceeds should be used to fund private and public noise mitigation projects in affected areas.

* Flights should be capped at 2018-19 levels until a substantial reduction in disruption due to aircraft noise is achieved.

* CASA should be required to take account of WHO findings on the health and safety impacts of noise pollution in setting rules for airport operation

Reducing harm from aircraft noise: an analysis of the economic and safety effects of the operation of Brisbane Airport

Introduction

Since the construction of the second runway at Brisbane Airport, aircraft noise over Brisbane suburbs has increased substantially. Brisbane Airport Corporation (BAC) has claimed that any restriction on flights would have substantial economic costs, and that the impact of aircraft noise on Brisbane residents has been overstated

The purpose of this submission is to provide an analysis of the adverse effects of aircraft noise on residential amenity and public health and a critical assessment of claims made by BAC.

Aircraft noise and property values

The standard economic approach to the measurement of the economic impact of local pollutants such as noise is the hedonic price estimation of house values. The underlying theory, tracing back to the work of Pigou (1920) and Coase (1960) was developed by Polinsky and Shavell (1976).

The following summary of the hedonic price method is taken from the meta-analysis of Nelson (2004):

> Consider two residential properties that are identical in all respects, except that one house is located close to or under an aircraft flight path, and the other is not. A but for analysis establishes that the adverse environment for the first house will result in a market value that is lower than the market value of the second house. This occurs because potential buyers reduce their demand for the first house relative to the second house, reflecting the discounted present value of the costs of annoyance, loss of tranquility, and possible health effects. A measure of the noise-induced damages is the difference between the market-determined value of the two houses. The analysis can be extended to

> analyze different levels of noise exposure because annoyance and other adverse effects of noise rise predictably with increased exposure levels (EPA, 1982; FAA, 1985; FICON, 1992a, 1992b). Hence, while there is a missing market for tranquility, a complementary market exists wherein individuals register their willingness to pay to avoid different levels of aircraft noise exposure. Consumers thus reveal the implicit value that they place on quietude by the explicit choices that they make in the housing market. The willingness to pay for quietude and other amenities are part of the asset price of the "housing bundle," and econometric techniques are available that unbundle complex products and thereby reveal the implicit or hedonic price. As indicated above, a large empirical literature has developed using the hedonic method.

Nelson goes on to explain the statistical procedures required to implement the hedonic price method, and to make results comparable using consistent measures of noise exposure.

All serious studies of the economic impacts of aircraft noise use the hedonic price approach (see for example, Cohen & Coughlin 2008; De Wit, et ald, 2006; Dekkers, & Straaten 2009,Kaur et al 2021, McMillen, D.P. 2004) and virtually all yield the unsurprising conclusion that the costs of living under a flight path are reflected in substantially lower prices compared to homes which are similar in other respects but do not suffer aircraft noise.

Finding A large body of international literature shows that the disamenity of aircraft noise is capitalized into land values. Based on international estimates, each additional dB of noise reduces land values by between 0.5 and 0.9 per cent

The QUT report

The QUT report (Eves and Blake 2014, 2021), commissioned by BAC, reaches the conclusion that house prices in Brisbane, unlike everywhere else in the world, are unaffected by aircraft noise.

As Eves and Blake summarise the existing literature

> A review of literature showed that the majority of academic studies in this area have been undertaken in the USA or The Netherlands with significantly less attention in the UK and Australia. Predominantly these studies have been based on econometric modeling using hedonic price models. Most commonly these studies found that there was some negative impact on residential properties. However, this was not the case for commercial and industrial property. Academic studies showed the impact of aircraft noise on residential property was only evident beyond 60dB and had no impact up to this level.

This summary is consistent with that given above

Despite summarizing the literature, and noting that "the overall theme in the literature studied was that the impact on residential property affected by noise from a national or international airport was 'universally negative'", Eves and Blake show no evidence of understanding the hedonic price model. First, they repeatedly object to the fact that most studies are undertaken over relatively short time periods. But this is entirely appropriate, since the hedonic pricing model describes the determinants of prices at a given point in time. Using a long time period would necessitate introducing the time of sale as a complicating factor.

Second, they observe (p 16) that

> "This shows that the impact of noise factors is only one of many factors that buyers take into consideration when they purchase a residential property and other factors may actually drive the market for individual property purchasers."

The whole point of the hedonic pricing model is to disentangle these 'many factors' and isolate the impact of noise. The standard econometric technique of multiple regression is designed to isolate the impacts of multiple factors in an explanatory model. Eves and Blake mention regression only twice (in passing) and appear to have no understanding of the technique.

Finally, Eves and Blake (p 19) observe that

> A further issue that is raised in these studies, but not actually tested in any of the models, is the fact that individuals have different levels of tolerance to noise and that people who are really adverse to high levels of noise will not purchase residential property in high noise locations.

But if there were sufficiently many buyers insensitive to noise, prices would not be affected. The observed market price reflects the fact that buyers who are choosing between locations affected and unaffected by noise are in fact willing to pay a premium to avoid noise.

The method used by Eves and Blake is to consider changes in prices in suburbs with varying degrees of exposure to noise over the period from 1988 to 2013. The use of suburb-level data is crude by the standards of the hedonic pricing literature, which had ceased using such aggregated data by the 1980s, and instead used house-level data which captured relevant characteristics such as land area, number of bedrooms, construction data and so on.

A more fundamental problem is that the airport was already in its current location in 1988. The disamenity of aircraft noise would already have been reflected in house prices in 1988. So, in the absence of information on changes in noise after 1988, the change in prices between 1988 and 2013 tells us nothing. The finding that price movements have been similar across suburbs with different levels of noise exposure is exactly what would be expected.

An updated report extends the analysis to 2020, and therefore includes a brief period after the opening of the second runway in July 2020. However, as Eves and Blake (2021) concede "the number of flights was reduced in 2020 as a result of the closure of international and at times the domestic borders due to the COVID-19 pandemic."

House prices have been highly volatile since 2020, so it is difficult to draw inferences from casual inspection of suburb-level movements in this period. Moreover, it is unclear when the impact of increased noise would have become evident to potential buyers. A proper hedonic analysis is required.

Given the magnitude of the investment in the second runway, and of the potential economic costs to residents of the affected areas, it is disappointing that BAC has chosen to rely on such a casual and technically inadequate piece of research to defend its position.

Finding: In denying the significance of noise effects on property values, Brisbane Airport Corporation relies on low-quality unreviewed consultant reports which contradict the findings of a large body of Australian and international research

Estimated effect of aircraft noise on residential land values

To estimate the effects of increased noise on residential land values, I undertook the following procedure. For each suburb identified by Brisbane Flight Path Community Alliance as severely affected, I used 2021 census data to determine the number of houses and units, sorted by number of bedrooms. Using data from realestate.com, I then derived the median house and unit prices. For suburbs with too few units for an adequate estimate, I treated a unit as being equal to 0.5 houses (See appendix).

I then used the impacts estimated in the meta-analysis of Nelson (2004) , which are expressed in terms of the percentage change in house prices per additional decibel of noise. Nelson gives a range of 0.5 to 0.9 per cent reduction in value for each additional decibel of noise. The corresponding range of effects on house values is $380-$690 million per decibel. For an impact of 10 decibels, the implied cost ranges from $4–7 billion. This may be compared to the cost of constructing the second runway, estimated in the range $1.1-1.3 billion

These costs may also be converted into annualised disamenity costs using the present value method. For a discount rate of 7 per cent and a noise increase of 10db, the implied annual disamenity ranges from $300 million to $500 million, equal to between $1800 and $3000 per person in the affected area, and between $15 and $25 per passenger using the airport.

Night operations

The ratio of costs to benefits for late-night flights from Brisbane Airport is exceptionally high. On a typical night, there are 6 to 10 international departures between 10am and 6pm, roughly one per hour. Each such departure provides a marginal convenience benefit to international airline operators and their passengers (say 300 per plane) relative to a daytime departure. Each departure also represents a potential sleep disturbance for 300 000 people living under

the flight path. Assuming passenger convenience gets the same weight as sleep disturbance, the ratio of costs to benefits is around 1000 to 1.

No other source of comparably avoidable noise is tolerated. Most noise sources are prohibited absolutely between 10pm and 7am. Drivers of noisy cars are routinely prosecuted. Queensland Rail makes strenuous efforts to minimise noise from rail operations.

While BAC regularly claims to make efforts to reduce noise from late-night flights, such claims have little substance. Even in my home suburb of St Lucia, which is relatively moderately affected, multiple sleep disruptions in a single night are commonplace.

At this point, it should be clear that nothing other than a curfew will suffice in reducing nighttime aircraft noise to reasonable levels.

Finding: The social costs of late-night international departures exceed the convenience benefits to airlines and passengers by a ratio of around 1000 to 1.

Recommendation Brisbane Airport should be subject to a curfew from 10pm to 6am

Policy responses

The disamenity associated with aircraft noise is a classic example of a negative externality (Pigou 1924, see also Coase 1960). The standard remedies include a pollution tax or a negotiated reallocation of carbon tax.

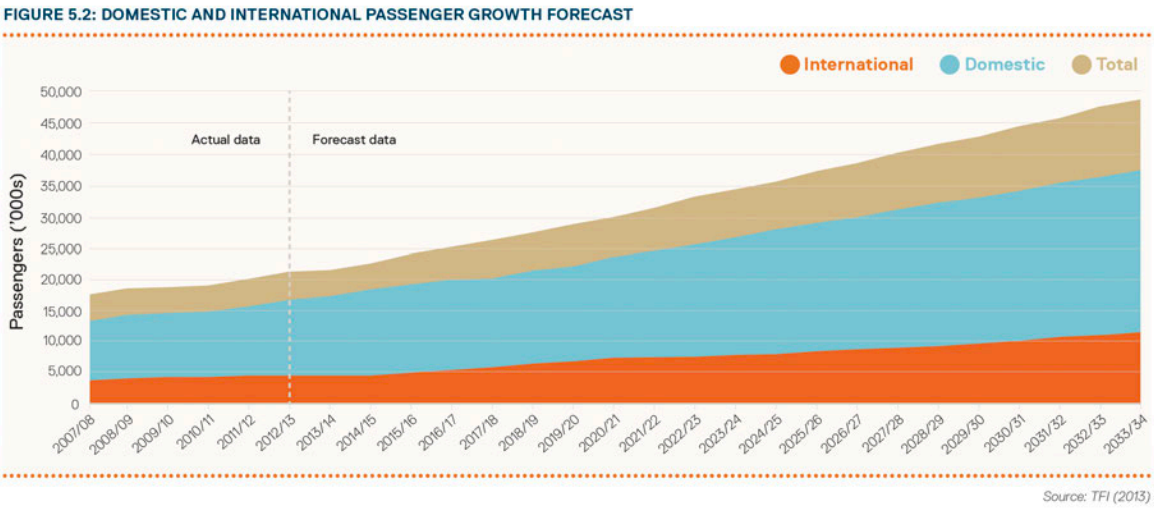
As BAC observes, requiring airlines to compensate residents for the disamenity of noise would raise the cost of air travel. This is true of all kinds of charges levied on polluters and is economically appropriate. If air travellers do not bear the full costs of the service they consume, there will be too much air travel.

Recommendation Air travel to and from Brisbane airport should be subject to a charge representing the costs of aircraft noise. The proceeds should be used to fund private and public noise mitigation projects in affected areas.

Economic analysis of airport operations

Historical and projected growth

The BAC case for rejecting any restrictions on flights rests heavily on the projection that passenger numbers will reach 50 million by 2035. This projections was put forward in the 2013 Airport Master Plan, and has been repeated consistently since then. The projection implied an annual growth rate of 5.4 percent in passenger numbers, well in excess of population growth.



BAC Forecasts 2012-2033

The reality has been far different. Passenger numbers have been essentially static in the 10 years since the Master Plan was released. The graph below, from the latest BAC Annual Report shows that growth had fallen far below the projected path by 2017-18 (23 million against a projection of 27 million). Since then, passenger numbers have fallen back to to the level prevailing in 2012-13. There were 20 million passengers in 2022-23, compared to a projection of 30 million. Reaching the projected 50 million would require annual growth of 8.4 per cent, which is highly implausible.

BAC Actual FY-18 to FY23

Travel restrictions associated with the Covid-19 pandemic depressed passenger numbers for several years. However, most restrictions were removed by early 2022, and none applied in 2022-23. Hence, there is no reason to believe that travel in 2022-23 was adversely affected by Covid restrictions. If anything (as noted in the BAC report) we might expect some 'catch-up' as people undertook journeys that had been deferred because of Covid restrictions.

The experience of the Covid pandemic has had some durable effects on demand for air travel. Of necessity during the lockdown period, people found ways of managing their lives that did not involve travel. Most notably, in-person business meetings were replaced by online alternatives. Although the adjustment was painful, online meetings are easier to organise and essentially costless. The resulting reduction in business travel is likely to prove permanent.

An obvious implication is that the massive increase in aircraft noise associated with the introduction of the second runway has so far been unnecessary. The old runway was capable of handling a larger volume of passengers than are using the airport at present. The capacity constraints led to some delays and inconvenience for air travellers. However, the same is true of traffic calming and other measures which reduce the costs imposed by road users on residents of the areas through which they travel.

Taking account of the increase in the average size of aircraft, it seems unlikely that the number of flights to and from the airport will return to the FY19 level for some years. A cap on flights would create a further incentive to employ larger and more modern aircraft.

In summary, a cap on flight numbers, restricting them to FY19 levels, seems entirely feasible. Such a cap would of course largely nullify the value the BAC investment in the second runway. But this is commonly the case with infrastructure investments based on inflated demand projections and a failure to take account of negative externalities, as in the case of the second runway.

Finding Projections of massive growth in passenger numbers, making the second runway an unavoidable necessity were clearly over-optimistic even before the Covid 19 pandemic. There has been essentially zero growth in passenger numbers since 2012-13, rendering the economic case for the second runway largely invalid. The BAC projection of 50 million passengers by 2035 is unrealistic and undesirable.

Recommendation Flights should be capped at 2018-19 levels until a substantial reduction in disruption due to aircraft noise is achieved.

Marginal benefits of airline operations

No city of any size can function without an airport. Hence, there is little point in attempting to evaluate the operations of BAC with reference to a counterfactual where no airport existed. Rather, it is necessary to evaluate costs and benefits at the margin, with reference to, say, a 10 per cent increase or decrease in the number of flights.

The marginal benefits of additional flights may be estimated using standard economic techniques based on the concept of consumer surplus. For example, if an airline passenger is paying $100 for a ticket, but would be willing to pay $110 (and no more) for the same ticket, the passenger has a consumer surplus of $10.

Using the concept of elasticity of demand, we can estimate the loss (or gain) of consumer surplus associated with an increase (or reduction) in the cost of airline tickets. Most estimates of the elasticity of demand are around -1. This implies that the increase in consumer surplus associated with a 10 per cent increase in supply is of the order of 1 per cent of total expenditure. Applying this estimate to total airport revenue of $850 million yields a consumer

welfare benefit of $8.5 million a year. This is substantially less than the marginal costs of even a small increase in aircraft noise

Finding: The economic losses associated with dis-amenity from aircraft noise in Brisbane are substantial, and at the margin, exceed the benefits of additional capacity at the airport

Health and safety effects of airport runway operation

Risk: perception and reality

Fears about the perceived risks of air travel are widespread, and routinely reinforced by media reporting. Although fatal crashes in commercial aviation are vanishingly rare, minor equipment failures, involving no loss of life or even injury, receive extensive global coverage. By contrast, loss of life associated with other modes of transport receives limited attention, if any. This imbalance has been reflected in public policy.

Risks associated with air travel are minimal

There are few human activities less dangerous than taking off in a commercial airliner. In the last five years (since March 2019), Wikipedia reports there have been only seven commercial airline crashes involving more than 50 fatalities, none of which occurred in an OECD country. These are

2023 Yeti Airlines Flight 691: A turbo-prop airplane crashed on landing in Nepal apparently due

2022 China Eastern Airlines Flight 5735: A Boeing 737. believed to have been deliberately crashed by the pilot

2021 Sirijawa Air Flight 182: A Boeing 737 crashed in Indonesia, caused by a combination of a faulty autothrottle and pilot error

2020 Pakistan International Airlines Flight 8303 An Airbus A320 crashed on attempted landing, caused by pilot error

2019 Two Boeing 737-Max crashes caused by faulty control systems

There were no major crashes caused by problems in take-off during this period or, as far as I can determine anywhere in the last ten years. And, with the exception of planes deliberately crashed by pilots or shot down by military forces, there have been no large-scale fatal crashes in any OECD country for well over a decade.

Estimating the risk of a fatal jet airline crash in Brisbane.

Although there have been no recent fatal crashes involving Australian commercial airliners and no major crashes anywhere in the world associated with failures on take-off, it is impossible to say with certainty that such a crash will never occur. However, it is possible, using standard statistical techniques to put an upper bound on the probability that such a crash will occur.

To illustrate, suppose that a coin is tossed 20 times and comes up heads every time. It is highly unlikely (less than 1/1,000,000) that such a result would occur with a fair coin. A simple calculation shows even a biased coin, which comes up heads 80 per cent of time, is highly unlikely to produce such an outcome. In statistical terms, we can reject the hypothesis that the coin has a bias of 80 per cent or less with a confidence level of 99 per cent. On the other hand, in this case, a bias of 90 per cent can't be ruled out in the same way. So, if we are unwilling to accept a 10 per cent risk of being wrong, we might not conclude that the coin is double-headed.

The same reasoning applies to airline crashes. Over the last five years, there have been approximately 150 million commercial airline takeoffs around the world with no fatalities involving major loss of life. Using the same reasoning as in the example above, we can reject, with 95 per cent confidence, they hypothesis that the risk of a crash on take-off is greater than 0.000002 per cent, or 2 in 100 million. With around 100 000 departures from Brisbane airport, we can be highly confident that we are unlikely to see a crash more than once every

500 years. A best estimate, taking account of longer term trends, would be closer to once every 5000 years[1] .

Estimating premature deaths due to aircraft noise in Brisbane

Noise exposure has a wide variety of adverse health effects. For the purposes of this submission I will consider only the best-established relationship between noise exposure and premature death, namely the resulting increase in fatal cardiac infarctions (heart attacks).

International studies have found a linear relationship between excessive noise exposure and ischemic heart disease, the primary cause of heart attack. Each 10db of additional noise increases the rate of ischemic heart disease by around 9 per cent (ENVISA 2023, see also Foley 2024, and Lawton & Fujiwara 2016).

Based on average prevalence for Australia, around 55 people living in severely affected suburbs would experience a fatal heart attack in any given year. A 10 per cent increase in that risk would imply 5 to 6 additional premature deaths each year.

This is a lower bound estimate. It takes account of only one health impact, and is confined to the most severely affected suburbs.

Finding Aircraft noise is a major public health problem, contributing to a substantial increase in the risk of heart attacks, including fatalities, in areas with high noise exposure, as well as many other adverse effects

Finding The International Civil Aviation Organisation and the Civil Aviation Safety Authority pay little or no attention to these predictable health and mortality effecs, focusing instead on tiny reductions in the already minuscule risk of airline crashes.

Recommendation * Aircraft noise is a major public health problem, contributing to a substantial increase in the risk of heart attacks, including fatalities, in areas with high noise exposure, as well as many other adverse effects

[1] This number may be compared to the '1 in 100 year' and '1 in 1000' year flood events commonly used in assessing the safety of dams, where catastrophic failure can cause large loss of life.

* The International Civil Aviation Organisation and the Civil Aviation Safety Authority pay little or no attention to these predictable health and mortality effecs, focusing instead on tiny reductions in the already minuscule risk of airline crashes.

Conclusion

BAC and government agencies involved in regulating air transport have started from the premise that the over-riding goal of policy should be the provision of cheap and convenient air travel, with essentially zero risk of accidents. In the pursuit of this goal, airport operations have been managed in a way that imposes substantial economic and health costs, including excess mortality on Brisbane residents.

The construction of the second runway with the selected configuration and operating procedures was a mistake, which will entail substantial economic losses. At present those losses are being borne by Brisbane residents. It would be more appropriate for BAC and its customers to bear this loss.

Appendix

Suburb	Pop	Houses	Median Price[1] ($m)	Apts	Median Price[2] ($m)	Total value	Loss ($m)	Loss ($m)
Ascot	6531	1367	2.4	1264	0.55	3976	199	358
Brisbane City	13716	3766	1	961	0.61	4352	218	392
Brookfield	3650	1120	1.65		0	1848	92	166
Bulimba	7407	1758	1.95	1120	0.72	4235	212	381
Chapel Hill	10371	3600	1.3			4680	234	421
Chermside West	6611	2380	0.9			2142	107	193
Coorparoo	17810	3777	1.7	3737	0.55	8476	424	763
East Brisbane	6118	1264	2	1289	0.54	3224	161	290
Hamilton	6776	1046	2.9	1902	0.61	4194	210	377
Hawthorne	5112	1349	2	478	0.62	2994	150	269
Hendra	4949	1700	1.7			2890	145	260
Inala	19891	6200	0.6			3720	186	335
Murarrie	4775	1700	1		0.6	1700	85	153
Norman Park	6857	2018	1.5	505	0.6	3330	167	300
Pullenvale	2023	652	1.8			1174	59	106
St Lucia	12220	1568	1.7	2350	0.6	4076	204	367
Rochedale	7663	2900	1.4			4060	203	365
Samford Valley	12385	3950	1.6			6320	316	569
Stones Corner	2336			1500	0.6	900	45	81
Upp. Brookfield	857	296	1.6			474	24	43
Teneriffe	5520	314	2.6	2405	0.8	2740	137	247
Toowong	12428	1714	1.7	3552	0.6	5045	252	454
Total	**176867**	**2324**		**5957**		**76549**	**3827**	**6889**

1. 4BR House
2. 2BR Apartment
3. Loss from a 10dB noise increase, assuming 0.5 per cent per dB
4. Loss from a 10dB noise increase, assuming 0.9 per cent per dB

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