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Andreas Knorr/Andreas Lueg-Arndt/Barbara Lueg

Airport Noise Abatement as an International Coordination Problem
- The Case of Zurich Airport -

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Table of Content

1. Introduction

The ongoing debate about the climate changing effects of aviation has largely "silenced" the discussion of effective and economically efficient noise abatement strategies.[1] This negligence is amazing, given the fact that noise is the most pressing – and, for the general public, the most widely felt – environmental effect of airline operations. Researchers have known for years that airport noise harm the physical and mental health of human beings. Even if noise levels around airports dropped by the reduction of noise emission of individual aircraft[2] it does not mean that the general public does not feel disturbed. The population is still obvious affected, due to the fact that the air transport market has grown continuously over the last decades and it will continue to rise.[3]

From an economic point of view airport noise is an externality in the traditional sense of being a byproduct of an economic activity – passenger and cargo flights (plus road, rail or sea/river feeder traffic) – which is not accounted for in the price system and therefore leads to market failure. As any other environmental externality, airport noise should, for maximum ecological and economic efficiency, be internalized at its very source using the most efficient and cost-effective policy instrument available. The crucial problem in determining the appropriate instrument for that purpose is the lack of sufficient knowledge of the cost of the externality and the undefined property rights.

Moreover, conventional wisdom holds that, because airport noise is a strictly local environmental problem, and the costs and benefits of airport operations typically accrue to locals only as well, internalization efforts with respect to airport noise pollution should be relatively simple and straightforward to design, implement and enforce (at least compared to global environmental problems). As the long-lasting "noise

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1 A preliminary version was presented at the Air Transport Research Society's (ATRS) annual conference in Athens (Greece) on July, 8th, 2008.

2 Improvement, especially in the domain of engine technology, has reduced the specific noise emission about 25 dB in the last 30 years. See Deutsches Zentrum für Luft und Raumfahrt e.V. (2004: 1 f.). – 10 db more/less typically mean a doubling/halving of the perceived loudness.

3 See *Arps/Hermann/Zimmer* et al. (2006: 1).

war" between Switzerland and Germany with respect to Zurich's Kloten Airport demonstrates, however, this is not necessarily the case.

2. Social costs of airport noise

As mentioned above airport noise is from an economic point of view an externality. The existence of an externality prevents that the total or social costs[4] of an action will be revealed in the market process – only private costs will be included in the calculation of the market price. For an economic analysis it is first and foremost important to analyze and evaluate the overall social costs of an action. Several studies tried to identify and to assess the social costs of airport noise. These studies are commonly using one of the two following approaches: *direct interviews*, to reveal the preferences of the public or their willingness-to-pay for noise abatement measures, or regression analyses, to evaluate house prices in the areas surrounding airports. Studies, for instance, show that there is a significant relation between air traffic noise and price reduction for residential housing.[5] Monetising these effects Morrell/Lu determined that the average cost of noise per aircraft varies from 2 € per landing and take off to 523 €, depending on the characteristics of different airports. The observed cost structure was correlated with the housing density in the airport's surrounding.[6] Other studies reveal that a lot of people feel annoyed and restricted in terms of their life quality.[7]

The above mentioned approaches have two main scarcities. First, they do not assess the adverse health effects of airport noise in general. The European Commission, for instance, considers living next to an airport to be a risk factor for coronary heart disease and stroke, as increased blood pressure from noise pollution can trigger these maladies.[8] Second, the aforementioned approaches of assessing the economic costs of airport noise disregard that noise can cause changes in sleep

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4 Total or social costs are the sum of private and external cost. Social costs are the overall cost for the society whereas the private costs represent only the cost the polluter has to pay.

5 See *Eger/Köhler/Rübbelke* et al. (2007: 206 f.).

6 See *Morrell/Lu* (2007: 143 f.).

7 See e.g. *Schmid* (2005: 64 f.).

8 See European Commission (1997).

patterns and daily activities. Again, the European Commission estimates that 20 percent of Europe's population suffers from noise levels that it considers to be unacceptable, where most people become annoyed and where sleep is disturbed.[9]

Additionally airport noise may have negative effects on children's health and development. One study examining the impact of airport noise on children's health found, for instance, higher blood pressure in kids living near an airport than in those living farther away.[10] Another study found a link between chronic noise exposure at an airport and elevated nervous system activity and cardiovascular levels in children living nearby.[11] And a 2005 published study analyzed that kids living near airports in Great Britain, the Netherlands and Spain lagged behind their classmates in reading by two months for every five decibel increase above average noise levels in their surroundings. The study also associated aircraft noise with lowered reading comprehension, even after socio-economic differences were considered.[12]

These proven environmental effects of airport noise should for health and social reasons be reduced to an adequate and optimal level. In the economic sense, noise – in general or generated by air transport – creates external costs, which should be internalized. On this account we discuss in the next paragraph the usefulness of alternative environmental policy instruments for noise abatement purposes at airports.

3. Alternative environmental policy instruments

Environmental policy instruments may be categorized as follows:[13]

- regulatory (command-and-control) measures such as standards, which, for the ensuing analysis, will be further subdivided into input-oriented technology (or design) standards and output-oriented

9 Ibd.

10 See *Cohen/Evans/Krantz* et al. (1980: 231 f.).

11 See *Evans/Hygge/Bullinger* (1995: 333 f.).

12 See *Stansfeld/Berglund/Clark* et al. (2005: 1942).

13 See *Button* (1993: 91 f.).

performance standards (such as specified maximum noise levels; as these limits may also be met indirectly through mandatory, predefined operating procedures and restrictions, these will also be regarded as performance standards in this paper);

- market-based or market-oriented incentives such as pollution taxes and charges (to discourage polluting activities);
- market-creating instruments such as tradable permits; and
- others including land-use planning techniques or instructions like night curfews.

3.1 Selection criteria

To begin with, it is a well-established and fundamental principle of environmental economics that any (positive or negative) externality should, on efficiency grounds, be internalized as close to its source as possible. While in many real-world cases, it may not be feasible to enforce this first-best solution, e.g. because it is impossible or prohibitively costly to identify and track the polluter, especially if it is mobile, this particular problem does not thwart noise abatement in commercial aviation. What is more, since the negative effects of noise pollution are negligible at cruising altitude, reduction efforts need to focus only on aircraft and engine design, operating procedures (on approach, take-off and on the ground) and land-use planning. In other words: Aircraft noise is first and foremost a local – point-source – environmental externality.

This in turn raises the fiscal federalism issue as to whether noise abatement should, again on efficiency grounds, be a local, a national or an international responsibility. Two aspects are relevant in this context.[14] As the economic costs of noise pollution vary significantly across jurisdictions – because of diverging preferences (including the willingness to accept higher or lower than 'average' emission and immission levels), income differentials, and, most important, vastly different marginal abatement as well as marginal damage

14 For a comprehensive discussion including a rigorous survey of the relevant literature see *Oates* (1999).

costs[15] – there seems to be a wide scope for a highly decentralized approach. By contrast, the case for the spatial uniformity of standards rests upon the following two pillars:

- the 'race-to-the-bottom'-hypothesis, i.e. the fear that otherwise the interjurisdictional competition would force locals to lower their standards to economically and environmentally suboptimal, unsustainable levels so as to attract more business; and
- the notion that only globally harmonized standards would prevent a fragmentation of regulations – with enormously costly consequences for manufactures and airlines alike.

In our view, both arguments are ill-founded and irrelevant in the context of noise pollution. On the one hand, this is due to the fact that local residents, since the early days of commercial aviation, have (very successfully) demanded the imposition of ever stricter noise abatement policies around airports worldwide; in other words, there rather is plenty of empirical evidence of a steady 'race-to-the-top' in this area! The fragmentation argument, on the other hand, only holds water, and would only then pose serious economic problems as a result, if

- technology (design) and/or performance standards were, by a wide margin, the most efficient and effective environmental policy instrument available (an unfounded assumption, as we will discuss in more detail below); and
- if these standards were enforced by means of the country-of-destination principle (as opposed to the country-of-origin principle, i.e. mutual recognition).

Finally, it should be noted in this context, that international standardization may focus either on rather rigidly defined output criteria – as has traditionally been the case with ICAO noise standards or on agree-

15 Marginal damage costs may vary significantly due to differences in population density, meteorological, climatic, topographical and demographical conditions. Accordingly they may decrease over time, owing to advances in technology, innovative operating procedures, and intelligent land-use planning, or change in either direction in line with population and settlement patterns. Differences in marginal abatement costs primarily result from the use of alternative production methods (including engine technology).

ing upon of a common set of procedures and policy instruments with sufficient scope for fine-tuning at the local level.

Aside from satisfying the aforementioned more general principles, environmental policy instruments should be judged against the following criteria:[16]

- Economic and environmental efficiency: this means that the optimum level of pollution, where marginal abatement costs equal marginal damage costs, will be attained and the equimarginal principle will be satisfied.[17]
- low information requirement for policy makers and enforcement agencies;
- cost-effectiveness, including low transaction, administrative and enforcement costs;
- adaptability (to changing technology, climatic conditions etc.);
- (dynamic) incentives for further improvement and innovation; and
- impact on competition and international trade: to safeguard the welfare-enhancing effects of competitive domestic and cross-border markets, the least competition-restricting and/or trade-distorting policy instrument should be used by policymakers.

3.2 Ranking with regard to aircraft noise emissions

In this section we will perform an aptitude test of design standards, performance standards, pollution charges, tradable permits, and land-use planning to determine their respective usefulness for noise abatement purposes at airports. An evaluation of the usefulness of different instruments is impeded on the fact that the external costs of airport noise are not only a simple function of the type of the used aircraft or engine. The external cost may vary according to the chosen landing

16 See *Field* (1994: 181 f.); *Turner/Pearce/Bateman* (1994: 159 f.).

17 The environmental efficiency of an instrument is traditionally assessed by its ecological marksmanship and its time to take effect. The economic efficiency is measured by cost efficiency, the innovation effect, the competition effect and the structural effect.

and take-off procedures (which are arranged in cooperation between the local authorities, i.e. air traffic control and the airport operating company) or the prevailing wind conditions. Additionally the results of measuring noise levels – which become an essential facility in times noise-related charges or a permit trading system will be established – may be affected by surrounding or environmental noise.

3.2.1 Noise-related charges

The concept of environmental charges has been established by A. C. Pigou.[18] His idea was to navigate the behavior of people with the aim to reduce environmental pollution. In our case, charges could be used to reduce noise which is generated by aircraft. Charging noise means to race the costs of using an aircraft. The theory built up on the so called polluter-pays-principle. The polluter has an economic incentive to reduce or in other words to change his adverse environmental behavior.

Noise-related charges excel as the, by far, least trade- and competition-restricting noise abatement approach. Based upon an objective criterion – emission or immission levels –, they do not constitute an entry barrier, but can be designed to reflect the damage costs caused by different aircraft types (and their operators);[19] the equimarginal principle would then be satisfied. For this reason, they are also highly adaptable to changing conditions. Noise-related charges also score high for the strong economic incentives they create for the affected polluters to seek ever further improvements in order to reduce their fiscal burden. Polluters have the incentive to reduce noise emissions – otherwise they have to pay (charges). One way of avoiding charges is to create technical innovation. The induced improvement activities will stop as soon as the marginal cost of reducing noise emission exceeds the level of the raised charges. In this moment politicians have to decide if their preferred noise abatement level is reached or if charges have to be raised. What is more, since the technical and administrative infrastructure to measure noise levels and to impose sanctions for infringements against prescribed limits is already in place at all major

18 See *Pigou* (1920).

19 This point is quite important, because noise emissions vary between the different types of aircraft.

and most minor airports, there would be no additional set-up and implementation costs. Finally, there are information requirements for policymakers, but they are rather low compared to other environmental instruments.

Their only major drawback is the unclear relationship between the level of the charges and the total volume of noise emissions and, hence, overall noise pollution levels; in the end, the reduction effect depends on the price elasticity of demand, i.e. the (un)willingness of passengers and other airline customers to accept the, ceteris paribus, resulting higher price for airline services. Moreover, using charges means that policy-makers are not able to fix an exact emission level. They have to adjust the charge until the optimal level is reached.

Although for this reason, the economic efficiency of noise-related charges may seem hard to predict, this disadvantage is on the one hand mitigated by airport congestion. On the other hand, the enormous (upward as well as downward) flexibility of charges[20] as opposed to all other instruments discussed here leaves policymakers with sufficient latitude to gradually approach the optimum local level of noise pollution in a trial-and-error process.

Finally, the argument that noise-related charges might arbitrarily (and inefficiently) be set too low for political and rent-seeking reasons, is insofar unconvincing as it must be considered a universal qualification, applying no less to all other environmental policy instruments and noise-abatement approaches discussed here.

3.2.2 Tradable permits

In 1968, J. H. Dales was the first to write a paper with the idea of tradable permits.[21] Like noise-related charges tradable permits act in accordance with the aforementioned polluter-pays-principle. Policymakers determine a maximum cap of possible (noise) emissions, which will be subdivided into "smaller" emissions rights. These permits will be issued to the participants. Without a sufficient number of

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20 Some years ago landing charges at Frankfurt Main International Airport, Germany, contain a noise-related component. Quite a few other airports all over the world are pursuing similar strategies. For details see FRAPORT (2001: 16 f.); *Morrell/Lu* (2000: 305 f.).

21 See *Dales* (1968a: 797; 1968b: 93 f.).

emission rights the participants are not allowed to produce emissions. In this example they are only allowed to produce noise to the extent of owned emissions rights. The emission permits are tradable – they could be sold to or bought from other participants. Like charges, the advantage of tradable permits is that they can be designed to reflect the damage costs caused by different aircraft types (and their operators).

While being the favorite of environmental economists as a tool to tackle emission-related externalities, tradable permits must be considered a distant runner-up to noise-based charges in this context. First, since it is extremely likely that the introduction of emissions trading would be politically acceptable only if incumbents were grandfathered, it would spawn very similar trade-restricting and competition-distorting effects in favor of incumbents as caused by the command-and-control slot allocation procedures currently in use in most parts of the world. In other words, it would, at many major airports, create an additional infrastructure bottleneck on top of already existing (and worsening) capacity constraints. But even if authorities were willing and able to effectively prevent strategic hoarding of permits, incumbents may still resist this approach as it might also set a precedent as regards the feasibility and the effectiveness of a market for slots.[22] Moreover, during the transition to a system of tradable permits, significant set-up costs would have to be incurred. Especially for the first airport to implement tradable permits, set-up costs will be high. If there would be an airport willing to bear the risk first, set-up costs will drop for the following airports. Even if airports could learn from the experience of the already implemented carbon emission trading system in the EU, the emission market for noise tradable permits on an airport is much smaller as the EU emission market for CO_2, so there is only a limited possibility of a comparison. In our view, these significant disadvantages can neither be offset by tradable permits' above-average performance as to the criteria adaptability, economic efficiency (including satisfaction of the equimarginal principle), incentives for improvement, and information requirements for policymakers, nor by the fact that the maximum allowable (local) level of noise pollution is unequivocally determined by the number of permits available.

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22 The US has very successfully introduced emissions trading for some gaseous emissions.

3.2.3 Performance standards and technology (design) standards

Although having been discredited by economists as inefficient, environmental policy is still dominated by the regulatory, command-and-control approach using either performance or design standards to achieve environmental policy outcome. In general, standards have a special command. If somebody does not comply with the regulations, he will receive sanctions. One can distinguish commandments or prohibitions. Commandments mean that you have a limited range of environmental pollution that is not allowed to pass over. Prohibitions imply that a special polluting behaviour is strictly forbidden. Therefore standards have a high environmental effectiveness which is the huge advantage of standards. There are a lot of different types of standards but in this paper we want to discuss the important differences between performance or design standards, which we will elaborate in this section.

To begin with, the disadvantages of *performance standards* – with ICAO's Chapter 2, Chapter 3 and Chapter 4 noise standards as the single most important practical example in civil aviation –, however, are many and serious. First, while, in theory, an extremely flexible tool which may be custom-tailored to meet specific local requirements and preferences, this fragmentation is not an option under the traditional ICAO rules. From an economic point of view, performance standards must, for several reasons, be considered a second- or even third-best solution to noise abatement. First and foremost, and as opposed to charges and permits, they effectively allow operators to pollute the environment at no cost at all as long as the standards are not exceeded; in other words, all damage costs are borne exclusively by the affected third parties, i.e. local residents.

For this reason, the imposition of performance standards does not create any economic incentives to actively seek additional environmental improvements through innovative technologies or operating procedures either. The only way to boost for instance technical innovations is to reduce the performance standards each time the participants have achieved them. However, this type of regulation provides an incentive for the participants to produce innovations much slower than they could as they anticipate the regulators behavior.

Even worse from an economist's perspective, uniform performance standards à la Chapter 2, Chapter 3 and Chapter 4 increase the over-

all costs of noise abatement for their failure to satisfy the equimarginal principle, if marginal abatement costs differ amongst individual operators (which they do to a substantial degree, given the technological heterogeneity of their fleets, to name just one factor). To be more specific, this means that any politically mandated noise reduction goal, such as a 50 per cent cut in average noise levels, will only be achieved at higher than necessary total costs to society – and at higher costs than would be incurred if any of the more efficient instruments discussed above were used instead.[23] Finally, performance standards are basically flawed for another important reason: Only the operators know their respective marginal abatement and compliance costs. This inherent and insurmountable informational asymmetry confers the operators an important strategic advantage vis-à-vis the regulatory body which is very likely to result in the mandatory standards being way too lax with respect to the local optima. These substantial disadvantages are partly offset, however, by – as least in the case of globally recognized uniform standards à la Chapter 2, Chapter 3 and Chapter 4 – their small trade-distorting and competition-restricting effects.

While most of these characteristics also apply to *technology standards* (such as the non-addition and by-pass rules set by the EU in the meanwhile withdrawn Regulation 925/1999), they are plagued by at least two more – and even more detrimental – flaws. Conceived as an all-or-nothing approach to noise reduction they leave the affected parties no room at all for manœuvre: either they are met or the affected airlines (or more precisely, their owners) are barred from operating their aircraft into and out of airports located in these jurisdictions. Effectively, this amounts to a tremendous restriction of competition both at the airline level and amongst competing engine manufacturers. Last not least, technology standards are far inferior to performance standards in one more crucial respect: more often than not there is no clear connection between the technology standard (an input!) and the stated environmental objective it was designed to meet (an environmental output!).

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23 See *Field* (1994: 214 f.), for a full discussion.

3.2.4 Land-use planning

The idea to pre-emptively reduce noise pollution around airports through sophisticated land-use planning, for instance by disallowing development of neighboring residential areas is without a doubt a very plausible and sensible one. Ideally, the noise 'footprints' of arriving and departing aircraft would then be largely felt within the airports' own boundaries only, causing no (significant) externalities outside. However, this is at best a long-term solution to the problem. Even worse, it inevitably fails to deliver on its promise at most existing airports located in the densely populated metropolitan areas of Europe, Asia and the US. Nevertheless, land-use planning is from an environmental and economic point of view an important factor. Especially in the planning process of a new airport or during the renovation of an older one land-use planning has to be a main interest. Even if there are only few possibilities to affect the grown areas, there might be possibilities to change the construction and constitution of the airport itself to reduce the noise for the people in the neighborhood. For example by a new constitution of the airport the landing of the aircraft will change which is likely to considerably reduce noise emission.

3.2.5 Other instruments

In addition the instruments discussed above, two other internalization methods are possible, though not widely used. First, some airports, most notably Düsseldorf in Germany, have imposed – or forced to do so by the courts – de facto *noise quotas* through mandatory *ceilings for aircraft movements*. In the case of Zurich Airport, this policy instrument – the so-called "*Plafondierung*" – has been strongly supported by local anti-aircraft noise groups. Compared to its market-based or more market-oriented alternatives, this instrument creates much weaker economic incentives for noise reduction for all parties involved, as it is typically imposed on top of existing procedures. Moreover, its anticompetitive effect is obvious at congested airports where slot allocation is based on grandfathering.

Finally, in a classic treatise published 1960, Ronald Coase proposed bilateral negotiations between the polluter and the affected parties as an efficient approach to internalizing positive and negative ex-

ternalities.[24] Recognizing the reciprocal nature of externalities as well as the legal concept of 'older rights' (i.e. grandfathering) efficient outcome would see either the polluter compensating the victims of pollution for their economic losses (polluter-pays-principle) or the victims compensating the polluter for any loss of income should he decided to stop the polluting activity (victim-pays-principle). While often discarded as impractical and inefficient due to potentially high transaction costs, if many parties are involved and if one side faces many small negotiating partners, its importance in international politics is obvious. In fact, in a world of sovereign nation-states, a negotiated solution à la Coase is behind every single international agreement, including all international environmental agreements, which in turn, might arrange for the use of any of the instruments discussed above.

3.2.6 Summary

The following table briefly summarizes the main results of our analysis. For the arguments mentioned above however, land-use planning has not been ranked.

24 See *Coase* (1960).

Table 1: Assessment of alternative environmental policy instruments

	Noise-related charges	Tradable permits	Standards		Land-use planning
			Performance	Technology (Design)	
Maximum economic and environmental efficiency	–	+	–	– –	
Low information requirements	+	+ +	+ +	+ +	
High cost-effectiveness	+	– –	–	–	
High adaptability	+ +	+	+	–	
Strong (dynamic) incentives	+ +	+ +	– –	– –	
Minimum impact on competition and international trade	+ +	–	+	– –	

Source: Authors' design

4. Case Study: The German-Swiss 'noise war' over Zurich Airport

4.1 Zurich airport's key traffic statistics

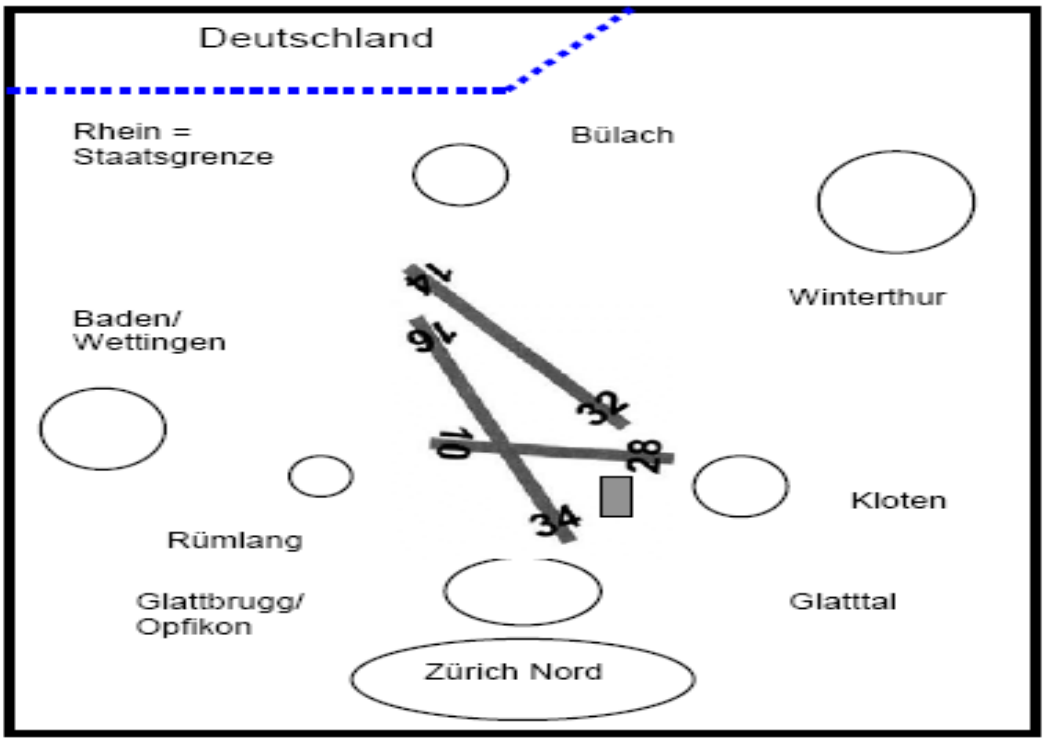
In 2009, Zurich's Kloten Airport handled 262,121 flights (2008: 274,991, i.e. minus 4.7 per cent), 240,500 of which were commercial operations. Passenger figures shrank by 0.8 per cent compared to 2008 to 21,926,872, turning Kloten into Europe's 11th busiest passenger airport.[25] In addition, the airport handled 344,415 tons of freight (2008: 387,671 tons). Around one quarter of all intra-European passenger flights serving Zurich were connections to German airports.

25 See Flughafen Zürich (2010: 31).

Kloten serves as the home base of Swiss, successor of defunct Swissair, which controls almost 50 percent of all traffic (47.9 percent of all flights, 48.2 percent of all passengers). After Swiss's complete takeover by Lufthansa, effective July 1st, 2007, the airport has effectively become the German flag carrier's third hub after Frankfurt (FRA) and Munich (MUC). Lufthansa operates 4.8 percent of all flights at Kloten and carries 7.0 percent of all passengers. The third largest carrier is Air Berlin with shares of 3.1 percent and 2.3 percent, respectively, followed by some smaller Swiss charter operators.

Kloten Airport, which officially opened for traffic on August 29th, 1953, is located 11 kilometers north of downtown Zurich, Switzerland's most densely-populated agglomeration. Especially to the South and to the East, the airport borders on urban and industrial areas. Unsurprisingly, noise abatement as well as the reduction of other types of aircraft-related emissions have long been important concerns for the airport's management and its local regulators. For example, Zurich airport was one of the first worldwide to introduce noise-related landing fees in an attempt to encourage airlines to use more modern, less noisy aircraft. Kloten operates three runways. Due to topographical restraints, the two longest of the airport's three runways – 10/28 (2,500mx60m), 14/32 (3,300mx60m) and 16/34 (3,700x60m) – are set up in a northwesterly-southeasterly configuration (see Table 2 below).

Table 2: Runway configuration at Kloten Airport (not to scale)



Source: *Bossonet* (2002: 6).

4.2 The Swiss-German 'noise war'

While the map displayed above is not to scale, it shows the closeness of the Swiss-German border, which is only 15 kilometers to the north-east of the airport. As a result, all flight landing at (or departing from) Zurich from (to) northerly and north-westerly directions typically had to cross German air space. Under normal meteorological conditions all landings took place from the North, while take-offs were carried out towards the West.[26] Before the German government imposed its restrictions, this translated into more than 150,000 aircraft movements per year which overflow German territory at low altitudes. The Swiss-German 'noise war' dates back to the early 1970ies when the first affected counties and municipalities on the German side of the border

26 Zurich airport is served via 4 alternative approaches, the most important being the northern approach over German territory. It was used for about 75 percent of all movements before the German restrictions took effect and spared most of Zurich's downtown and metropolitan areas (*Thuy* 2004: 172).

urged local and federal politicians to intervene on their behalf.[27] This resulted in the bilateral agreement of September 17th, 1984, which regulated the use of German airspace for flights to and from Zurich and which aimed at limiting the number of approaches into Kloten at below 100,000 movements annually.

After the inhabitants of Kloten canton had opted in a referendum for the expansion of the airport, the number of movements quickly exceeded this threshold, however – with a vengeance. Attempts by the Federal German government to achieve some improvements for the affected German parties were met with indifference on the Swiss side and remained unsuccessful. The situation escalated, however, after the 1998 change of government in Germany which, for the first time in the country's history, brought the Green Party to power at the Federal level in a coalition with the Social Democrats. On March 22nd, 2000, the then acting German Minister of Transport, Reinhard Klimt, unilaterally terminated the 1984 agreement with effect from May 31st, 2000, and demanded a negotiated settlement in the shape of a legally binding *Staatsvertrag* (intergovernmental treaty). Otherwise, he threatened that the German government would restrict the German air space unilaterally for flights to and from Switzerland by means of an administrative act (i.e. by signing an implementing regulation for the purpose).

The *Staatsvertrag* was indeed successfully concluded and signed by representatives of both sides on October 18th, 2001. Not only did it stipulate a ceiling of 100,000 movements per year over German territory; this was equivalent to a 20 percent reduction in the number of flights, in other words: the vast majority of all flights into Kloten would still begin in German air space. Moreover, a complete curfew was imposed from 22.00 until 06.00 on weekdays and from 20.00 till 09.00 on weekends and (German) public holidays; to be introduced gradually, its first stage became effective October 19th, 2001 by means of a preliminary enforcement order. In other words, during these night curfews, all aircraft approaching into and departing from Zurich were banned from the German air space. Finally, Switzerland committed itself to establish holding patterns over its own territory.

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27 The following subsection draws heavily on Südkurier (2007a), *Bosonnet* (2002), and European Commission (2003).

On the Swiss side, several thousands homes near Zurich airport were immediately exposed to substantially higher noise levels, as a result of the inevitable change of approach lanes.

However, the intergovernmental agreement was never ratified in either Parliament. In Switzerland, it was vetoed by the *Nationalrat* and returned to the transport commission by the *Ständerat*, both citing an unacceptable German dictate, while in Germany it was accepted by the *Bundestag*, but rejected by the *Bundesrat* (the second chamber which represents Germany's sixteen state governments). On October 21st, 2001, in reaction to the *Nationalrat*'s veto, the German government issued yet another implementing regulation which unilaterally put these restrictions into effect – permanently. Swiss attempts to overthrow the regulation before German courts failed because no unlawful breach of bilateral agreements, and no discrimination or out of proportion action by the German side could be proven (also, because the state government of Baden-Württemberg, which borders on Switzerland, had imposed a similar curfew for flights to and from Stuttgart airport). On April 17th, 2003, the German government extended the nocturnal curfew from 21.00 until 07.00 on weekdays, and imposed further operational restrictions. The Swiss government reacted with a complaint before the European Commission, but also sought mediation. Both initiatives produced no results: The mediation failed soon after, while the Commission sided with Germany's legal position and, in late 2003, confirmed the legality of Germany's action without any qualification.[28] The Swiss government then took the case to the European Court of First Instance which, in its ruling on September 9th, 2010, rejected the complaint (Case T-319/05). In parallel, bilateral negations have continued ever since, but produced no tangible results except for joint studies to measure the levels of noise pollution in the affected areas on both sides of the Swiss-German border.

In the canton of Zurich, a referendum was held on November 25th, 2007. There was a choice of two proposals. Proposal one, based on an initiative of some citizens' groups, provides that a strict ceiling of 250,000 take-offs and landings per year be implemented at Kloten Airport, 5 percent less than current levels, and that the nocturnal curfew be extended from currently 7 to 9 hours. Proposal two, put forward by the *Volkswirtschaftsdirektion* (Economic Commission) of the

28 See European Commission (2004).

Canton of Zurich, centers around the highly complex "Zürcher Fluglärm-Index" (Zurich Aircraft Noise Index). Extremely controversial, and discarded by most affected residents, it attempts to measure the maximum allowable level of noise pollution, but not on the basis of objective decibel levels. Instead critical levels of aircraft noise, which are supposed to automatically trigger political abatement measures once they have been reached, are derived from subjectively perceived annoyances as a result of aircraft movements, including sleeplessness and adverse psychological effects.[29] Zurich's electorate voted clearly in favor of the second proposal.

In the latest two twists to the tale, Lufthansa and its fully-owned subsidiary Swiss have commissioned a detailed economic and environmental impact analysis of Kloten's operations with a strong focus on the German counties and municipalities right across the border. Moreover, the Swiss government is planning to introduce a modified northern approach into Kloten, the so-called "gekröpfter Anflug" ("crooked" approach). Under this new approach lane, aircraft would enter Swiss air space at a much higher altitude and to the northwest of Zurich. Their path would then lead them along the Swiss-German border, but entirely over Swiss territory until they would begin their final descent with a steep right-hand curve some 10 miles out. This new procedure is about as strongly rejected by neighboring German and the affected Swiss localities, in particular the canton of Aargau, as it is favored by residents and politicians in the Zurich metro area who would see their expose to noise pollution decrease to the old, pre-'noise war'-levels as a result.

4.3 Analysis – why was no compromise reached?

Before Germany's unilateral action, both the exposure to aircraft noise and the substantial regional economic benefits[30] generated by Zurich Kloten were distributed very unevenly between German and Swiss residents. The former suffered disproportionately from the negative externalities, while at the same time, they did not receive any monetary compensation. Moreover, most of the positive economic effects

29 See Oliva & Co. (2006) and Amt für Verkehr des Kantons Zürich (2006) for details on the index.

30 See Swiss International Airport Association (2003), economiesuisse (2007).

which are generated by Kloten accrue to Switzerland in general and the Zurich region in particular. For example, only 1.0 percent of the airport's employees were German citizens, only 3.0 percent of all contracts (in terms of contract value) put out to tender during the last round of airport expansion were won by foreign bidders, and only 1.0 percent of the overall economic benefits generated by the airport spill-over to the Southern part of Germany.[31,32] In other words, local Swiss residents and companies benefited substantially from taking a free-rider position and effectively exported a large chunk of the economic costs of the inevitable noise pollution across the border without any meaningful compensation, or even compensation offer.

The immediate – and lasting – effect of the curfew imposed by the German implementing regulations was a substantial geographic redistribution of noise emissions and noise patterns, however. In fact, some quarters in the Zurich region – including the city's famous, and well-to-do "Gold Coast" residential area on the North shore of Lake Zurich – which had been spared almost all aircraft noise beforehand –, suddenly found themselves exposed to high noise level, in particular during the (German) curfew hours. This affects around 13,000 local residents, while 15,000 up to 28,000 residents suffer from higher noise levels; this compares to some 4,000 people, which reside north of Kloten Airport and were partly relieved from aircraft noise due to changing approach and take-off patterns. Overall, it has been estimated by the Swiss government that, as a result, around 210,000 Swiss nationals have to endure to a permanent noise level of 50 decibels as opposed to as few as 750 on the German side of the border.[33]

The crucial issue is: why did bilateral negotiation between Germany and Switzerland fail? Economic theory predicts that any government will only strike a deal with another country if the agreement delivers a net benefit for the country, i.e. if it can achieve economic and/or political gains with respect to the status quo ante. This includes the avoidance of sanctions which may have been imposed by the other party in the case of non-agreement. The likelihood that a

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31 See *Thuy* (2004).

32 Ironically, since Lufthansa's rescue-by-takeover of SWISS, it is effectively a German company which generates most of the airport-related economic benefits for the Zurich region and Switzerland as a whole.

33 See *Bosonnet* (2002: 8), Tagesanzeiger (2007).

deal will be reached also depends on the negotiation strategies pursued by the two countries, which may either be profit-oriented or distribution-oriented.[34] While the former attempts to reach the maximum benefits for all parties and is based upon fairness and cooperation, the latter describes a rather uncompromising attitude which aims to maximize own profits at the expense of the other party, e.g. by insisting on one's own position and by exploiting existing informational asymmetries at the expense of the other side. In this scenario, a deal can only be reached if the issue at stake is part of a broader package of issues which are negotiated simultaneously and if the distribution-oriented side wishes to benefit from a concession from the other in a different area.

Applied to the Swiss-German 'noise war', Switzerland could have expected the German side to act on behalf of their affected citizens because the number of aircraft movements to/from Kloten from/to the North had grown substantially to more than 100,000 per year. However, the Swiss side erred on two counts: First, that the German side would continue to accept the extremely uneven distribution of benefits – in favor of the Zurich area – and social costs – a larger share of which was borne by the affected German regions. Second, that the German government would not take unilateral action in case of non-agreement (a reaction which the Swiss side erroneously thought would be interpreted by the courts as discriminatory and an out-of-proportion solution to the problem). This is astounding since, also for two reasons. First, the Swiss side, i.e. Zurich airport, its shareholders and stakeholders, would also have gained from a deal since it would have created legal certainty with respect to the use of German air space. Second, given Switzerland's close economic ties and heavy economic dependence on much larger Germany, there was no scope for successful retaliatory action against Germany as a reaction to the curfew.

In fact, one sensible solution would have seen the Swiss side extending its programme of financial compensation to those affected by aircraft noise to German citizens as well; so far, only Swiss residents are eligible. Moreover, the affected German regions, which are heavily dependent on tourism, could have been offered better connections to Kloten Airport by an extension of Switzerland's excellent metro-rail links across the border.[35]

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34 See *Fornahl/Springmann* (2001), *Althammer* (1988).

35 See *Thuy* (2004: 177 f.).

5. Conclusion

The Swiss-German ‘noise war’ archetypically highlights the problems, but also potential solutions, of reaching effective international agreements to cross-border environmental externalities. Currently, given the Swiss government’s broad support for the “gekröpfter Nordanflug”, a further escalation rather than a mutually beneficial negotiated solution seems likely. Ironically, it is a German company which has most to lose from the impasse: Lufthansa, the 100 percent-owner of SWISS and as such Kloten Airport’s key customer.

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