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Introducing an Airline Ticket Tax in Switzerland:

Estimated Effects on Demand

THE CLIMATE EFFECTS OF SWISS AVIATION

Aviation is Switzerland's second largest emitter of greenhouse gases

19% TODAY, UP FROM 14% IN 2010

- 1 Ground transportation 25%
- 3 Residential buildings 15%
- 4 Industry 15%
- 5 Agriculture 10%

PARLIAMENT'S PROPOSAL: 30 TO 120 CHF per airline ticket

Could reduce air traffic by up to 20% and greenhouse gas emissions by up to 10%

Results: the proposal could cut Switzerland's total global warming impact by up to 2%

Introducing an Airline Ticket Tax in Switzerland: Estimated Effects on Demand¹

Marius Brülhart², Fleance Cocker³, Dominic Rohner², Philippe Thalmann³

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Summary:

Air travel accounts for a large and rapidly rising share of Switzerland's global warming impact: some 19% today, up from 14% in 2010. Technology is not improving fast enough to offset booming demand for flying. The Swiss parliament is therefore considering the introduction of an airline ticket tax.

We provide first-pass estimates of the impact of such a tax on demand for air travel and on emissions. The tax currently considered – 30 to 120 CHF per airline ticket – would significantly curb demand. It could reduce air traffic by up to 20% and associated greenhouse emissions by up to 12%. This would cut Switzerland's total global warming impact by up to 2%. At the rate at which kerosene sales have been rising over the last decade, these emissions savings would be offset by growth in the demand within three years.

Since long-haul flights account for an estimated 79% of emissions with only 22% of passenger volume, the mitigating impact on emissions could be strengthened through a more progressive rate schedule, featuring top rates above the ceiling of 120 CHF and low rates below 30 CHF. Interestingly, such an improved emissions outcome could be attained with a smaller drop in passenger numbers compared to our interpretation of Parliament's baseline scenario.

Any ticket tax will have a stronger impact if indirect flights via European hubs are not taxed as short haul but as long haul and if transfer flights are included. We do not simulate distributional impacts of the airline ticket tax but note that the tax foreseen by Parliament would generate revenues of up to 1 bn CHF per year.

¹ This policy note builds on work for a White Paper that is currently being prepared by the Environmental Policy platform of the Enterprise for Society Center (E4S), a joint venture of the University of Lausanne (UNIL), the Institute for Management Development (IMD) and the Ecole Polytechnique Fédérale de Lausanne (EPFL). The members of the platform are: Marius Brülhart, Rafael Lalive, Dominic Rohner, Simon Scheidegger, Mathias Thoenig (UNIL-HEC), Ralf Boscheck, Michael Yaziji (IMD), Philippe Thalmann, Gaetan de Rassenfosse (EPFL). Important preliminary work was carried out by Nikolai Orgland, under the supervision of Philippe Thalmann.

² University of Lausanne – HEC Lausanne

³ EPFL

Air Travel – a Large and Growing Contributor to Global Warming

Air travel currently accounts for an estimated 19% of Switzerland's total global warming impact – up from 14% in 2010.⁴ This makes aviation our country's second largest emitter of greenhouse gases, behind ground transport (25%) but ahead of residential buildings (15%), industry (15%) and agriculture (10%). Emissions from air travel are increasing also in absolute terms, with an average growth rate of over 3.3% since 2010.

The implication of these numbers is clear: the growth of aviation emissions needs to be significantly curtailed if Switzerland is to meet its agreed climate targets. There are two ways of achieving this aim: either flying becomes cleaner, or people fly less.

Given the undoubted economic, social and personal benefits that air travel procures, the preferred option would be for flying to be made cleaner. Progress has been achieved: aircraft engineering has yielded considerable gains in fuel efficiency, and dynamic pricing strategies have increased load factors. In the coming years, biofuels and synthetic kerosene might contribute to fuelling aircrafts in carbon neutral fashion.

These technological developments are welcome and deserve further encouragement. However, it appears overwhelmingly likely that technological change alone will not suffice to reverse or even significantly slow the rising global warming impact of aviation.⁵ Two numbers underline this assessment: while Swiss air travel emissions have been increasing on average by 3.3% annually since 2010, passenger numbers have been increasing by 4.9%. Hence, environmental efficiency gains have only managed to offset about a third of passenger growth. The likelihood that such gains could reverse the growth in aviation's global warming impact in the near future therefore appears close to zero. Technological improvements are simply swamped by the increase in passenger numbers.

So, how could the volume of air travel best be reduced? Among the various regulatory tools available, market-based instruments are usually preferred, as they are economically efficient: pollution abatement is achieved at the least cost for society as a whole. Typically, policy makers choose between two market-based instruments: they can either regulate the volume of air travel through cap-and-trade policies (i.e. setting quotas), or they can influence the price of air travel through taxes. The former, commonly referred to as the quantity instrument, sets a limit to emissions and lets the market determine the corresponding price. The latter, commonly known as the price instrument, sets a price for emissions and lets the market determine the corresponding amount of emissions.

Neither of the two mechanisms clearly dominates the other. Generally speaking, when deviations from the optimal emissions level are more harmful in environmental terms than in purely economic terms, quotas are to be preferred; otherwise, taxes are better suited.⁶ Outside the world of economic models, this theoretical distinction is difficult to quantify and to operationalise. Hence, actual choices of policy instruments largely rely on the practicality of implementation and their political acceptance.

⁴ Our calculations are based on FOEN (2019). We include domestic as well as international flights through Swiss airports. We moreover account for the current scientific consensus that a correct measure of the global warming impact of air transport requires that its CO₂ emissions be given twice the weight of corresponding emissions on the ground, to reflect the release of further harmful gases and the magnified climate impact of high-altitude emissions (Jungbluth and Meili, 2018; Lee *et al.*, 2009).

⁵ According to one optimistic scenario, synthetic kerosene might account for 5% of fuel use "soon after 2030" (Patt, 2019).

⁶ See Weitzman (1974) and Baumol and Oates (1988).

Individual flying quotas would represent the most direct measure to reduce air travel demand. Every Swiss resident would receive the right to emit a given amount of CO₂, or to fly a certain number of kilometres per year. To allow for differences in preferences and travel needs, such quotas would be made tradable. The total amount of quotas could be gradually reduced over time, allowing precise control of the volume of air travel – independently from changes in fuel prices and other cyclical factors. The main drawback of such a measure lies in its implementation: keeping track of individual air travel would be administratively costly, intrusive and effectively applicable only to long-term Swiss residents.⁷

Taxes therefore appear as the more realistic demand-side policy tool – especially within a small open economy like Switzerland. Environmental taxes are a textbook case for potentially desirable government intervention in the market economy. Global warming clearly generates large and rapidly rising costs, but in a free market economy nobody is asked to pay to mitigate these costs. The reason behind this “market failure” is that the earth’s climate is not the property of any particular individual or group of individuals, and so no private individual or group can claim compensation from those who do damage to the climate. The government thus has to step in and to ensure that, in the famous phrase, the polluter pays.

This is the motivation behind proposals for a Swiss airline ticket tax.⁸ The federal parliament is currently discussing the introduction of a tax ranging between 30 and 120 CHF per air passenger departing from a Swiss airport, except in transit or transfer. Differential rates are envisaged according to the length of flights (short-haul vs. long-haul) and according to the type of ticket (Economy vs. Business). A minority of parliamentarians has suggested applying the 30-120 CHF range only to economy class tickets, and allowing for higher tax rates on business and first-class tickets. These proposed tax rates are higher than those in force in most other European countries.⁹ The exception is the United Kingdom, where per-ticket tax rates go as high as 172 GBP (for long-haul flights in business class).

The Crucial Role of the Demand Elasticity

The extent to which an airline ticket tax will affect the volume of air travel mainly depends on a simple parameter: the elasticity of demand.¹⁰ This parameter quantifies consumers’ sensitivity to changes in the price of flying. The elasticity is undoubtedly negative: the higher the tax, the lower will be the demand for flying. Much more uncertain is the magnitude of the elasticity. The larger the elasticity (in absolute value) the more effective a given increase in taxation will be at lowering demand for air travel. If demand is inelastic, tax-induced price raises will hardly translate into substantial declines of passenger numbers, while with elastic demand even moderate price increases will trigger a strong reduction in passenger numbers.

⁷ An administratively less onerous solution would involve quotas for offered transport capacity (flights and seats) from Swiss airports, a refinement of the existing landing or take-off slots.

⁸ Other initiatives to reduce air travel greenhouse emissions include the industry’s own CORSIA plan and the European Union’s emission trading system (ETS). In their current guises, these initiatives do not seem to hold significant potential for reducing the global warming impact of air travel. In principle, other taxes are also conceivable (general carbon tax, specific tax on kerosene, VAT, airport charges, etc.). Given the specific proposal currently discussed in Switzerland, we do not consider these alternative instruments.

⁹ Similar taxes have been implemented in Austria, Croatia, Finland, France, Germany, Greece, Italy, Norway, Poland, Romania, Slovakia, Spain, Sweden and the United Kingdom. Average per-ticket tax rates range from EUR 0.60 (Slovakia) to EUR 40 (United Kingdom). See European Commission (2019).

¹⁰ The elasticity of supply will also play a role. The lower that elasticity, the larger will be the share of the tax that will be absorbed by airlines (e.g. through lower pre-tax prices and thus lower profit margins) and not shifted to consumers. Given the competitive nature of the European airline industry, we abstract from these effects and assume perfectly elastic supply.

Typically, the more flexible a customer is, the more sensitive she is to the price. When alternatives abound, price raises get harshly punished by clients who simply switch to another transport mode (e.g. high-speed and night trains) or to another activity (e.g. video conference, holiday closer to home). Empirical studies confirm this: passengers are more price sensitive for short flights (where other transport modes are available) and for economy-class flights (as private trips are often more flexible than business trips).

The most recent and comprehensive study of air travel price elasticities was commissioned by IATA, the trade association of the world's airlines, in 2007.¹¹ According to this study, the price elasticity for short-haul economy-class flights within Europe equals approximately -1.2. This means that when prices increase by 1%, passenger demand will decline by 1.2%. This same study reports an elasticity estimate for long-haul intercontinental economy-class flights of around -0.9. The corresponding estimates for short- and long-haul Business flights amount to -0.6 and -0.3, respectively. Quite strikingly, these estimates imply that within-Europe economy-class travellers are four times as price sensitive as inter-continental business-class travellers.

These numbers, however, must be considered to be lower bound estimates. The reason is that they stem from econometric estimations that typically ignore – like most estimates in the related academic literature – an important methodological pitfall: price changes are not random and reflect underlying demand conditions. If for example the price increases by 1%, this may be due to seasonal factors (summer weather, Christmas rush) or to the business cycle (general increase in activity). Even if such a price increase is associated with, say, a 1% drop in demand this may well under-estimate the actual demand sensitivity, as the demand decline will be attenuated by the favourable conditions that have led to a price increase to start with. Put differently, if one were able to control for all such context-related factors, one would likely find elasticity estimates that are substantially larger.¹² The authors of InterVISTAS (2007) were aware of this methodological problem and, for a subset of elasticities, proposed alternative estimates that circumvent the statistical issue by exploiting exogenous variation. In these estimates, the elasticities found are magnified by 75%, leading almost to a doubling of the effects. We therefore also consider “upper-bound” elasticity estimates that are augmented by this factor.

Table 1 summarises the range of lower-bound and upper-bound estimates for short- and long-haul and Economy and Business flights that we use for our simulations.

¹¹ InterVISTAS (2007). This study has since been used as reference for policy reports both for Switzerland (Peter et al., 2009) and for the EU (European Commission, 2019). We are not aware of a more recent and methodologically more accomplished (ideally quasi-experimental) study. There is a glaring lack of research in this area.

¹² Technically, the problem is attenuation bias due to endogeneity. Price changes are both cause and consequence of demand changes, but what we seek to estimate is only the causal link from price changes to demand changes.

Table 1: Demand Elasticities

Elasticity estim.	Short-Haul Economy	Long-Haul Economy	Short-Haul Business	Long-Haul Business
Lower bound	-1.2	-0.9	-0.6	-0.3
Upper bound	-2.1	-1.5	-1	-0.5

Notes: For the lower-bound, the short-haul Economy estimates correspond to the averages of the InterVISTAS (2007) estimates of 1.23 and 1.12, the long haul-Economy estimates are given by the average of the following four InterVISTAS (2007) estimates: 1.06; 0.96; 0.79; 0.72. The business estimates correspond to the aforementioned Economy averages minus the Business elasticity reduction estimated in Brons et al. (2002). For the upper bound, the four aforementioned values are each multiplied by 1.75, based on the difference between IV and OLS estimates reported in InterVISTAS (2007). The elasticities in the Table apply for leisure-related flights in Economy and work-related flights in Business. For the estimated 27% of flights in Economy that are work-related, with use elasticities intermediate between those of Economy and Business.

Simulating the Effects of a Swiss Ticket Tax

We use the estimated demand elasticities for a first-pass estimation of the impact of a range of possible tax schedules on passenger numbers, kilometres flown and emissions caused.¹³ The specific question we ask is how passenger numbers and emission volumes would have differed in 2018 if a given ticket tax schedule had been in force.

The Swiss parliament's project does not yet specify a schedule for the ticket tax. So far, it only sets a lower and upper bound – 30 and 120 CHF, respectively – and mentions the possibility to differentiate by travel class and flight length. We therefore consider four scenarios, three of which are based on the current proposal. These scenarios are summarised in the upper panel of Table 2, and estimation results are shown in the lower panel of Table 2. Note that the Parliament's proposal exempts transfer flights from the ticket tax, even though they account for 15% of all passengers departing from Swiss airports.

In our **first tax scenario**, short-haul economy-class passengers pay the minimum tax of 30 CHF, and short-haul business-class passengers pay 60 CHF. For long-haul flights these amounts are set at 90 and 120 CHF, respectively. We suppose that only the destination of the first leg of a connecting flight is used for setting the tax rate (e.g. somebody flying to Boston via London would benefit from the short-haul rate). This scenario entails a reduction in CO₂ emissions of between 7% (lower bound) and 11% (upper bound).¹⁴

Our second and third tax scenarios relate the ticket tax to the climate impact of flights. The average short-haul flight in economy class emits the equivalent of 104 kgCO₂ per passenger with the high-altitude factor. It is taxed in the **second tax scenario** at 30 CHF. The average long-haul flight in business class emits 3.5 tCO₂ per passenger and is therefore taxed at the top 120 CHF rate. The other

¹³ The simulations are based on a number of additional parameters. We use the following representative return ticket prices (in CHF): 170 for short-haul Economy, 740 for short-haul Business, 590 for long-haul via hub Economy, 2580 for long-haul via hub Business, 840 for long-haul direct Economy and 4650 for long-haul direct Business. We take 670 km as the representative short-haul distance and 8,000 km as the representative long-haul distance. We assume 78% of trips to be short-haul, 5% to be long-haul through a European hub, and 17% to be long-haul direct. Assumed CO₂ equivalent emissions in kg per km and person, including the factor 2 for high-altitude emissions, are as follows: 0.15 in short-haul and long-haul Economy, 0.23 in short-haul Business, 0.42 in long-haul via hub Business and 0.43 in long-haul direct Business.

¹⁴ Despite the graduated rates according to this scenario, short-haul economy-class flights see the strongest price rise (18% relative to the average return price for such flights, but transit passengers are exempted), while the relative price increase is much smaller for long-haul flights (11% in Economy and 3% in Business).

ticket taxes range between these extremes, proportionally to the corresponding emissions. It turns out that this ticket tax schedule has a somewhat smaller impact on travel demand and emissions as the one of the first scenario. This is because short-haul business flights and long-haul economy flights are taxed less than we assumed in scenario 1. The results of this second scenario are the ones to be expected if the Federal Council sets the ticket tax rates in accordance with (relative) emissions.

Our **third tax scenario** considers a tax of 96 CHF per ton of CO₂, which corresponds to the rate set for heating fuels under the Swiss CO₂ Act.¹⁵ Airline ticket tax rates consistent with this existing CO₂ tax would differ substantially from those currently envisaged by parliament. They would range from 10 CHF for the average short-haul flight in economy class to 347 CHF for the average long-haul flight through a European hub in business class (not counting the emissions of the return flight). This scenario implies a slightly stronger reduction of kilometres flown and emissions but the smallest impact on passenger numbers. Indeed, the number of passengers depends essentially on what happens for the bulk of passengers who fly short-haul, while kilometres and emissions depend essentially on the treatment of long-haul flights. A proportional carbon tax would affect the latter much more than the former.

In our **fourth tax scenario**, we apply the maximum rate of the currently considered range, 120 CHF, to all tickets (except transfer). This scenario implies that the average ticket price for short-haul flights in Economy is increased by 70%, which could reduce Economy passenger numbers on short-haul flights by up to 55% and total passenger numbers by up to 43%. Of all the scenarios we consider, this would also bring about the sharpest reductions in CO₂ emissions (by up to 20%).

¹⁵ Rate for 2018 to 2020. CO₂ emissions from airplanes are, again, counted double to account for the climate impact of high-altitude emissions, in line with the current scientific consensus estimate (as discussed above).

Table 2: Simulations

		Tax rates (CHF)			
	Scenario:	(1)	(2)	(3)	(4)
Short-haul	Economy	30	30	10	120
Short-haul	Business	60	31	15	120
Hub	Economy	30	30	124	120
Hub	Business	60	31	347	120
Long-haul	Economy	90	59	114	120
Long-haul	Business	120	120	332	120
		Estimated effects, based on lower-bound elasticities			
Passengers		-12%	-11%	-6%	-30%
Pkm		-7%	-6%	-8%	-15%
CO ₂		-7%	-5%	-7%	-13%
Tax revenue (m CHF)		961	804	883	1'971
		Estimated effects, based on upper-bound elasticities			
Passengers		-19%	-18%	-10%	-43%
Pkm		-12%	-10%	-13%	-23%
CO ₂		-11%	-9%	-12%	-20%
Tax revenue (m CHF)		881	736	832	1'492

Tax scenarios:

- (1) Our interpretation of the schedule envisioned by Parliament, flights through European hubs being treated like short-haul flights
- (2) Tax rate proportional to CO₂ emissions in the 30-120 CHF range, flights through European hubs being treated like short-haul flights
- (3) Tax rate according to climate impact (CO₂ emissions × 2, at 96 CHF/ton CO_{2eq})
- (4) Tax set at maximum rate for all segments

Overall, our simulations suggest that introducing a tax within the currently debated 30-120 CHF rate range could cut CO₂ emissions by up to 11%.¹⁶ Given the weight of aviation in Switzerland's total global warming emissions, this would imply a reduction of up to 2% of that total. At the rate at which kerosene sales have been rising this last decade, these emissions savings would be offset by growth in demand within three years. Since long-haul flights account for an estimated 79% of emissions with only 22% of passenger volume, the mitigating impact on emissions could be strengthened through a more progressive rate schedule, featuring top rates well above the ceiling of 120 CHF. Interestingly, such an improved emissions outcome could be attained with a smaller drop in passenger numbers than in the baseline Scenario 1, and this despite the smaller elasticities in the long-haul segment.

It is important to note that our simulations are too crude to allow us to quantify the distributional impact of different scenarios.¹⁷ While the airline ticket tax is independent of passengers' income, long-haul and business-class travellers typically have higher incomes than short-haul and economy-class travellers. This does not necessarily imply that the proposed ticket taxes will be progressive, as they might burden less well-off travellers relatively harder than better-off travellers.

¹⁶ Not considering the rather unlikely fourth scenario.

¹⁷ We also abstract from supply-side reactions, from income effects, from tax-induced deadweight losses and from dynamic and indirect effects. Our estimates are therefore to be considered as rough and partial approximations rather than as a comprehensive evaluation.

Whether the overall effect of the tax is progressive, will moreover also depend on how the tax revenues are used: the greater the weight of lump-sum redistribution (via health insurance premia), the more redistributive will be the direct effect of the policy. Depending on the schedule of the ticket tax and the elasticity of demand, associated tax revenues range between roughly 0.7 and 1.0 bn CHF (Table 2)¹⁸ – a little less than the revenues of the CO₂ tax on heating fuel (1.2 bn CHF).

Complementary Measures: Information, Infrastructure and Innovation

While this note focuses on the direct effects of a ticket tax, other, complementary policy instruments exist. While money matters, it is obviously not the sole motivator of human behaviour. Information campaigns have for example played a major role in countering adverse effects of tobacco, and public information on the global warming effects of flying combined with the negative message that the tax itself sends could potentially magnify its impact.

The provision of attractive alternatives to air travel will also facilitate adjustment in travel behaviour. The availability of high-speed long-distance train connections could reduce the wedge in travel speed between planes and trains. Night trains seem to hold particular potential. A general increase in the price of flying, e.g. through an airline ticket tax, would enhance the price competitiveness of alternative travel modes even without additional public subsidies.

Finally, technological innovation in the aviation sector should continue. Apart from public support to research and development in this sector, rules for minimum contents of “green” aviation fuels may be worth considering.

¹⁸ Not considering the rather unlikely fourth scenario.

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