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Does the aviation Emission Trading System influence the financial evaluation of new airplanes? An assessment of present values and purchase options

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ABSTRACT

In this paper we assess the impact of the CO_2 costs for short- and long-haul aircraft based on present values and on purchase options. We evaluate purchase options with a framework developed for real option analysis to estimate the value of flexibility under uncertain kerosene and CO_2 prices. We find an average influence of CO_2 costs on present values of €1.1 million for the short haul plane and €4.1 million for the long-haul plane over the typical lifetime of an airplane. For purchase options, we find a CO_2 influence of €0.43 million for the long-haul plane and a moderate impact for the short-haul plane. The results underline the importance of CO_2 and kerosene costs for long-haul aircraft.

1. Introduction

To curb the increase in carbon dioxide (CO_2) emissions of aviation, the EU has decided to include airlines in the EU's Emission Trading Scheme (ETS), that was planned to begin in January 2012 but was subsequently postponed until April 2013, and for foreign operators until at least 2014. One measure to achieve carbon neutral growth in aviation is the replacement of older aircraft with newer, more fuel-efficient aircraft. Among other factors, the price of kerosene and, for airlines affected by the ETS, the price of CO_2 influence the airlines' decision to purchase these planes. Both factors, however, show considerable uncertainty with respect to their future development.

Here we focus on the potential effect of the ETS on the present value of a new airplane in a deterministic environment and its impact on purchase options in the presence of uncertain kerosene and prices. We based our estimates on the initial time frame for the introduction of the ETS for aviation.

2. Methodology and input variables

To evaluate the financial impact of the CO_2 costs in an environment without uncertainty, we distinguish between a short-haul aircraft based on existing technology (Airbus A321) and a long-haul aircraft (Boeing 777-300ER) that can be replaced with more efficient hardware. Variables dependent on the aircraft type are denoted by an index $a = \{1, 2\}$, where 1 refers to short-haul aircraft. For time-dependent variables, an index y represents the specific year. The base year of our analysis is 2015; around this time the new technology airplanes will enter service. To distinguish between current and new technologies we use the index $t = \{1, 2\}$, where 1 represents the old airplane. Fig. 1 illustrates the main steps of the calculation. The data used are taken from published sources and interviews with experts.

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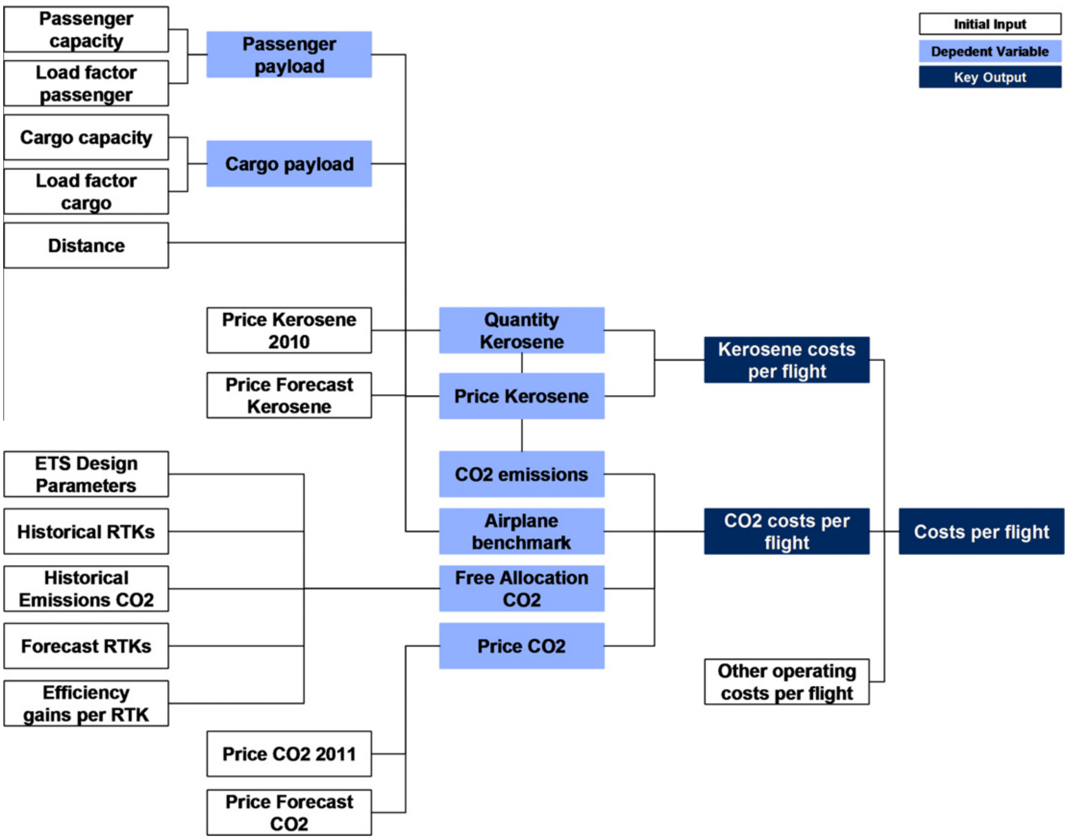

Fig. 1. Estimation stages and variables.

The independent variables used in the analysis are:

- *Allowance prices* (awp_y): We take current CO_2 prices from the European Energy Exchange (EEX) (approximately €10/tonne in 2012) and assume a growth to €38/tonne in 2030 (Schlesinger et al., 2011). We estimate volatility based on 2008–2011 (the second, more stable trading period for stationary emitters).
- *Cap reduction* (cap_y), auctioning share (auc_y) and special reserve (spr_y): For 2012–2020 we set these values as stipulated in the directive, i.e. a cap reduction of 3% for 2012 (5% for 2013 and the following years), a special reserve of zero for 2012 (3% for 2013), and an auctioning share of 15% for 2012 and 2013. We assume no changes to these values until 2020. For the year 2021, we assume no change to the special reserve, a cap reduction of 21% compared to 2005, which is similar to stationary emitters, and an increase in the auctioning share to 50%, comparable to competitive industries in the third trading period of stationary emitters, starting in 2013.
- *Cargo capacity* ($cargo\_cap_a$): Cargo capacity is set to 21(14) tonnes for the short-haul (long-haul) planes. These values are derived from the maximum take-off weights of the given aircraft types minus the weight of the passengers (including baggage) and the necessary fuel.
- *Distance* (dis_a): Kerosene consumption and an aircraft's individual benchmark allocation are based on the distance flown. We choose typical values for the specific aircraft types: For the short-haul aircraft, we set the distance to 1000 km (a typical continental distance) and for the long-haul aircraft we set it to 12,500 km (for example the distance from London to Singapore).
- *Efficiency gains from new airplanes* ($eg\_new\_ap_a$): New airplanes are generally more efficient than the generation they replace. The A321neo is to replace the A321 and scheduled to enter service in 2016; Airbus claims it will be 15% more fuel efficient (Airbus S.A.S., 2011a). For the long-haul aircraft, the Boeing 777-300ER, a comparable aircraft from Airbus is scheduled to enter the market in 2017, the Airbus A350-1000, entailing efficiency gains of 20%.
- *Emission factor*($efactor$): Set to 3.15 tonnes CO_2 per tonne kerosene.
- *Flights per day* ($flights_a$): For long-haul (short-haul) aircraft we set it to 1.5(6) flights per day, which is based on average speeds and thus travel times for the respective aircraft types.