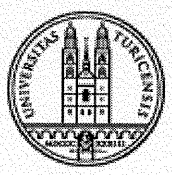

University of Zurich[UZH]

The Inclusion of the Aviation Sector into the EU ETS: A Real Options Approach

Master Thesis

in

Corporate Finance

at the

Department of Banking and Finance

University of Zurich

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Date of submission: 31.01.2013

Executive Summary

Problem and Objective

In 2008 the EU Commission decided to include the aviation sector into the EU Emissions Trading System (EU ETS). From January 1st 2012 onwards all flights and therefore airlines departing and arriving at an EU-based airport have to cover its greenhouse gas emissions according to defined allowances. The scheme is designed as follows: In 2012 85% of the allowances are allocated free of charge to the airlines, while in the period of 2013 to 2020 82% of the allowances will be given for free. 15% is auctioned on the market while the rest (3%) will be assigned to a deposit for later distribution for fast growing airlines and new entrants. Purchase rights of an aircraft can be valued with real options. This gives rise to the question what impact the EU ETS may have on the real options valuation and furthermore on the investment decision of manufacturers and airlines in a new aircraft.

Methodology

In order to evaluate the impact of the EU ETS on purchase rights of an aircraft two different models are created using Microsoft Excel. Both models include different scenarios where each scenario represents one possible allowance price. Furthermore, each scenario differentiates between two cases: the first case assumes a standard short- to medium-haul aircraft and the second covers a more fuel-efficient aircraft from the same category. The models are used to calculate the present value of the cash flows which are generated by the two different aircraft.

This thesis approaches the valuation in four steps: *First*, the revenues (cash inflows) are considered. It is assumed that the revenues follow a Geometric Brownian Motion (GBM). *Second,* the cash outflows are calculated. Next to fuel costs which follow a mean-reverting process, the models simulate other cost factors such as Maintenance, Repair & Overhaul (MRO) and the costs associated with buying the allowances to cover the emissions. *Third*, Monte Carlo simulations in a sufficiently high number are applied to the present value of the cash flows to estimate the mean present value of the cash flows. Monte Carlo simulations are also applied to the fuel costs. *Fourth*, based on the results received from the Monte Carlo

simulations the real option values in the different scenarios and cases are calculated and compared with each other to estimate the impact of the EU ETS on the real option values of new aircraft.

Theoretical Principles

To compare the real option values in this thesis different theoretical principle are applied. In order to get the cash inflows over a certain time period in an environment that is difficult to predict a stochastic process is assumed (GBM). The evolution of the jet fuel costs are simulated with a mean-reverting process, as jet fuel price changes are strongly correlated to movements of crude oil.

In order to get the present value of the cash in- and outflows, discounted cash flow method with an appropriate discount factor is applied. The next step includes the simulation of the present value of the cash flows. To do so, MCSim, a free Monte Carlo simulation tool is used as Add-In in Microsoft Excel.

The last step required the Black-Scholes formula to derive the real option values. The underlying values for the real options are the mean present value of the aircraft coming from the Monte Carlo simulation. The strike price is represented by the present value of the investments to buy the new aircraft. Time to maturity is the time period between signing the option contract and deciding whether or not the airline wants to exercise the option. The volatility of the option is determined by the underlying. Furthermore, a discount rate has to be chosen to value the real options.

Results

The results of this thesis show that an aircraft with higher fuel-efficiency can generate additional value in terms of cash flows to the airline and a higher real option value. In the first model where constant auctioning is assumed and 82% of the allowances are allocated free of charge to the airlines, the results indicate an increasing gap between the real option values as the price for one allowance increases. In the second model this value gap gets larger, showing the importance of allowances given free of charge for the cash flows and the real option value.

In order to avoid the additional financial burden airlines will eventually invest in new aircraft and rejuvenate their fleets. Knowing that airlines are looking for more fuel-efficient aircrafts manufacturers will eventually spend more money in investments to develop new technologies to offer more fuel-efficient aircraft. One can expect that the price of those aircraft will rise. Nevertheless, it won't rise significantly as the manufacturers are aware that the airline can easily get a better offer from the competitor. This competitor can expect a longstanding relationship with the airline or lay the foundation stone for further sales if the new aircraft can be sold.