Market Competition and Share Prices: The Case of the Airbus-Boeing Duopoly[1]

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Abstract

There is an extensive literature dealing with the share price reaction of competing companies within the same sector upon the announcement of important information. Our article studies announcements of new airplane orders and measures their impact on the share prices of the relevant airplane maker and its competitor. Our research is the first, to our knowledge, to examine the repercussions of events that have a direct impact on the profits of companies within the same sector. We put forth a series of hypotheses on the share price reaction of Boeing and EADS (parent company of Airbus) to their own order announcements and to those of their competitor while assuming, for the sake of simplicity, an absence of strategic effects. Our sample covers the period from the stock market debut of EADS in July 2000 to 31 December 2005. We show that the share price reactions conform to what one would expect, and we observe that the estimation of market reaction to new airplane order announcements is of reasonable amplitude. Moreover, it appears that the hypothesis of an absence of strategic effects is accepted. Our study highlights the difficulty of deducing the valuation the market makes of sales, even very big ones, from only the study of share prices.

Keywords: Duopoly; Event study

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1. Introduction

Boeing, founded in 1916, was the undisputed leader of commercial airplane makers for several decades. However, over the past fifteen years the European manufacturer Airbus, established in 1970, has entered into increasingly aggressive competition with Boeing and, from 1999, has consistently captured 50% of the market for airplanes of over 100 seats.

The aeronautic industry is a very specific sector, one that, in particular because of its economic weight, is considered highly strategic: it is important in terms of jobs, development and international trade. Moreover, the barriers to entry are so high that competition takes place only between the two giants, making the rivalry between Airbus and Boeing a fascinating example of a global duopoly.

Our article addresses one aspect of the competition[2] between the two aircraft makers. We noted for the period July 2000 – December 2005 the announcements of new orders that the airline companies placed with each of the two firms, and we then checked the impact of these announcements on the market capitalization of the two manufacturers[3]. Thus, by studying the

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[2] According to Porter's 5 forces model (1980), a strategic analysis tool used to study the value of the structure of an industry, analysis of competition identifies 5 fundamental forces:

1. rivalry between competitors: in the framework of the Airbus-Boeing duopoly, this is expressed in terms of product range and cost effectiveness (value for money)
2. customers: in the aeronautic sector the absence of intermediaries between manufacturers and airline companies facilitates negotiation
3. suppliers: still have some negotiating power
4. potential new entrants: unlikely given the high barriers to entry in the sector
5. threat of substitute products: unlikely in the aeronautic sector, at least for long-haul aircraft (short-haul airplanes could possibly face competition from the development of very high speed train networks).

[3] As Airbus is not listed directly, we study the impact on the market capitalization of EADS, its parent company, which holds an 80% stake in Airbus.

share price reaction of the two companies, we measure how the market perceives the competition between Airbus and Boeing following the announcement of new orders.

Indeed, generally speaking, when important events affect a company, they can also directly or indirectly impact its competitors in the same sector. Thus, when the financial media report information on a company, they comment not only on the share price movements of the firm in question, but also on those of the key actors in the sector. Consequently, the detailed study of the reaction of both the company concerned by the event and its rivals provides us with some insight into the nature of competition in the industry.

In fact, the interactions in the aeronautics market between Airbus and Boeing have often been studied. Lynn (1995) provides both a historical and a contemporary perspective on aviation, describing how Airbus and Boeing designed their key products, created a need for the product, and mobilized all their resources to reach their goals. In particular, he describes in detail (1995, pp.1-9) a battle that took place in 1993 over an order worth $6bn from the Saudi national airline, a battle which entailed particularly active lobbying from the American, German, British and French heads of state. When the stakes are so high, and mobilize so many heads of state, one can expect the order announcement to have a noticeable effect on share prices.

Furthermore, commentary by the media and market actors generally concludes that competition in the sector is extremely intense. The value of contracts signed in civil aviation is always based on the catalogue price of the airplanes. The real price of the transactions, whether with Boeing or Airbus, is often well below these prices, especially for the commercial launch of a new airplane. Now, what the financial analysts most fear is an all-out price war between the two aircraft makers, one that would reduce their profitability. Thus, according to Business Week (2002), the fight for an order from EasyJet for 120 airplanes, won in the end by Airbus despite the fact that EasyJet's existing fleet was exclusively Boeing, "raised fresh questions about whether Airbus is sacrificing profitability for market share". The magazine also reported that "most analysts believe Airbus slashed at least 40% off the A319's $50 million list price". Upon publication of this news item, EADS' share price dropped sharply. More recently, following the Paris Air Show at Le Bourget in June 2007, which signalled Airbus' ability to win big orders again after the turmoil it experienced the previous year, certain analysts said they "feared that Airbus has sacrificed its margins, in particular on its new A350, in response to pricing pressure from Boeing, whose B787 is a big commercial success even before a single delivery has taken place" (Reuters press release, 25/06/2007).

The intense interaction between the two competing firms has also given rise to strong academic interest. Many studies have dealt with the modeling of competition between Airbus and Boeing, Airbus being the firm that has defied Boeing's monopoly. Casadesus-Masanell et al. (2006) consider the two companies constitute a mixed duopoly, arguing that the objective function of the two companies is different, Boeing being owned by private shareholders, while Airbus is largely held by the French state. Other studies analyze Airbus' entry into the large airplane market in terms of the consequences for Boeing, consumers, airline companies, governments and European taxpayers. Thus, the competitive interactions are modeled by Baldwin and Krugman (1988) for the medium sized/medium haul segment; by Klepper (1990) for the three small, short-haul aircraft (type A320, B737) and the medium sized/medium-haul airplanes (type A300, A310, B757, B767), as well as the large, long-haul planes (Type B747). Klepper (1994) and Neven and Seabright (1995) complexify the study by also taking into account the third big manufacturer, McDonnell Douglas.

The conclusions of these models converge: the big winners are European governments, on one hand, thanks to Airbus' performance, and on the other hand, consumers. The big losers are the USA (Boeing) and European taxpayers.

Irwin and Pavnik (2004) study the impact of two major differences between the two competitors: the conflict that resulted in the treaty signed in 1992 between the European Union and the United States that limits subsidies, and the two firms' contrasting approaches to the evolution of the large airplane market, especially the B747 and the Airbus range, after the announcement of the future A380. Benkard (2004) studies the commercial aircraft makers via a dynamic oligopoly model. His model explains the sector's high concentration and the pricing policy within it.

Aktas et al. (2006) study the creation of EADS (the parent company of Airbus) and examine whether the European national authorities have set up a "credible" private competitor in the aerospace sector. They measure this credibility by the financial markets' valuation of the share prices of the companies concerned (the competitors in the aerospace sector: Boeing, Lockheed, Raytheon, BAE and the airline companies).

In our article, we concentrate on the way in which the stock market perceives the interaction of the two firms in the large airplane manufacturing sector: how do they integrate new orders in the revaluation of future cash flows of the two companies?

The idea of analyzing competing companies' share price movements around the date of important announcements is not new. Ever since the founding article by Fama (1969), event studies have proliferated in various research domains: bankruptcies (Lang and Stulz, 1992), acquisitions (Stillman, 1983, Eckbo (1983), Schumann, L. (1993), Banerjee, A. and Eckard (1998), Andrade, Mitchell and Stafford (2001), Warren-Boulton and Dalkir (2001)), LBOs (Chevallier, 1995), new product launches (Chen et al., 2002), dividend announcements (Paul et al., 1998), reporting of profits (Foster, 181), share buyback programmes (Hertzel, 1991), obtaining a listing on a foreign stock market (Melvin and Valero-Tonone, 2003), the publication of antitrust laws or new regulations concerning the opening of a sector to competition (McGuckin, R., Warren-Boulton F. and Waldstein P. (1992)), and the role of the European Commission in the approval or rejection of mergers and acquisitions (Aktas et al., 2001) and (Aktas et al. 2004).

Generally speaking, these studies enable one to assess how the market interprets an event that will have an impact of future cash flows (bankruptcies, mergers, buyouts, new product launches, etc.). These events, however, are not necessarily directly related to, or do not enable one to precisely estimate, the company's market share or turnover.

Our work is original in that it concerns the direct impact of sales on future cash flows. It is the first, to our knowledge, to examine the market's perception of events that have a direct impact on the company's profits and competition (concentrating on competition in terms of sales).

In the context of our study, we can assume that the sales policy of EADS and Boeing is the object of a non-cooperative game. Each firm can adapt its strategy by trying to anticipate the strategy of the other, while knowing that the competing firm is doing the same, and so on. These strategic effects can be reinforced by the massive investments required for the launch of new products (the cost of launching the A380 was $11.9bn, a figure that represents 26% of the total revenue of the sector and more than 70% of Airbus' total revenue in 2000). Lynn (1995) reports that the best salesmen for Airbus and Boeing were, respectively, François

Mitterrand and Bill Clinton. When negotiations involve such high-level politicians, it is reasonable to suppose that the negotiation of the deal is not only focused on price, but rather covers a much broader terrain (industrial cooperation, bilateral trade, etc.). Moreover, competition between the two companies does not take place only in the arena of the market, but is also reinforced by the fact that Boeing is American and Airbus is European, and they are competing to be the global leader in their sector. This entails support programmes for the two companies, including soft loans and more or less direct subsidies, which has resulted in both companies being taken to court on charges of unfair trade practices. This highlights the fact that the transactions involve stakes that go beyond the level of turnover of the companies themselves. As John Newhouse (1982) suggests, in a book that deals in particular with the launch of the B747, "the aeronautics industry, more than others, is one in which results are largely determined by strategic commitments".

It is thus probable that strategic effects exist: the market can detect, value and reintegrate them in its estimation of cash flows. These effects may sometimes explain why a share price reaction is contrary to what one would expect.

Our approach is based on the semi-strong efficient financial market hypothesis (Fama, 1970 and 1991). First, we used the classic event study methodology, checking whether on average the abnormal returns of EADS and Boeing shares were significant following new orders registered by one or the other firm. Then, in order to measure the impact of sales on the value of each firm, we modeled the abnormal returns expressed in dollars according to the size of the order.

Our results show that there is a link between the sales of each firm and their market capitalization. The share price reactions observed are generally what one would expect, namely a new order announcement has on average a positive impact on the company concerned and a negative one on its competitor. Announcements also have a symmetrical effect of similar size in absolute value on the two companies. The level of reaction in terms of the market's revaluation of the firms seems reasonable, even though it is not as high as analysts seem to think when they comment on new order announcements. Strategic effects, if they exist, do not, as a rule, seem to run counter to the expected reactions.

The rest of the article is organized as follows: section 2 presents the hypotheses that will be tested, section 3 describes the methodology, section 4 the data, while section 5 presents the results and section 6 is the discussion. Finally, in section 7 we conclude.

2. Hypotheses

Our objective is to deduce the market's perception of the state of competition between Airbus and Boeing from a study of the share price reactions to new order announcements made by the two companies. However, even though sales have a direct impact on profits, strategic issues can also play a role in how investors perceive this type of event. Indeed, in several cases, these issues can become more important than the direct profits from the given deal. If we consider, for example, another article (International Herald Tribune, 2003) reporting that "China signed a contract […] to buy 30 aircraft from Airbus, a big victory for the European airplane maker as it challenges Boeing in the fast-growing Chinese market. […] Airbus declined to comment on the size of any discounts given to the Chinese. […] 'We consider China a strategic market', [Airbus CEO] Forgeard said." Aside from any strategic consideration, new order announcements can contain information that goes beyond their direct effect on profits. However, the precise way in which these strategic effects should be taken into account is not clear. We are therefore led to formulate a series of hypotheses that assume that the only effect of new order announcements concerns the direct effect of sales on the profits of the seller (and thus the loss of earnings of the competitor, due to lost sales).

To assess the market's response, we used the event study methodology that is based on the semi-strong efficient financial market hypothesis. We have also assumed the absence of strategic and informational effects, which enabled us to set constraints on the estimated coefficients in the cross-sectional regressions. If these constraints are accepted, this implies the absence of strategic effects, or at least that such effects do not run counter to our hypotheses.

Our first hypothesis is simple: the share price reaction to new order announcements is a move in the expected direction.

H1: New orders constitute good news for the seller and bad news for its competitor

This comes down to testing whether, on average, the abnormal returns for EADS (Boeing) shares are significantly positive (negative) in the case of a new order registered by Airbus and significantly negative (positive) in the case of an order registered by Boeing.

Even though this hypothesis is based directly on the postulate that only direct cash flows from a sale are relevant, one can also interpret it more broadly: a company's decisions are supposed to be beneficial, or at least not detrimental, to its shareholders. The average reaction to announcements gives us information about the quality of management's decisions. This is all the more evident if shareholders correctly value the shares and if a significant part of the information in the new order announcement does not consist in new information about demand.

Thus our second hypothesis is:

H2: The bigger the order, the more positive the impact for the seller and the more negative for its competitor.

If one notes:
$\beta_{A,A}$ ($\beta_{A,B}$) : the impact of orders registered by Airbus (Boeing) on the EADS share price,
$\beta_{B,B}$ ($\beta_{B,A}$) : the impact of orders registered by Boeing (Airbus) on the Boeing share price,
This comes down to testing: $\beta_{A,A}>0$, $\beta_{B,B}>0$, $\beta_{A,B}<0$, $\beta_{B,A}<0$.

The literature on event studies recognizes that share price reactions are weaker for events that have been anticipated.

Since adding a new type of airplane to an airline's fleet can greatly increase its operating costs, we can suppose that given similar types of airplanes and the absence of significant price differences, airline companies would tend to stick to the same supplier. This argument, however, is less relevant for orders placed by leasing companies, and as the example of EasyJet shows, the case can arise wherein an airline places an order exclusively with Airbus even if its current fleet is only made up of Boeing aircraft. For these reasons, and also because

estimating new order probabilities is beyond the scope of our study, in what follows we assume that the probability of ordering from a given airplane maker is a constant, but not necessarily 50%. We assume that the marginal profit of each manufacturer is also a constant, respectively f_A and f_B, and that the probability for an order to go to one or the other of the competitors is p_A and p_B. Thus, for an order of Airbus airplanes (Boeing), the total value of gains (losses) not anticipated by EADS' shareholders is: $(1-p_A).f_A.X = p_B.f_A.X$ ($p_A.f_A.X$), where X is the size of the order. Conversely, for an order of Boeing airplanes (Airbus), the total value of gains (losses) not anticipated by Boeing's shareholders is:
$(1-p_B).f_B.X = p_A.f_B.X$ ($p_B.f_B.X$),where X is the size of the order.

In this case, we can write the following restriction:

H3 : $\frac{\beta_{A,A}}{\beta_{A,B}} = \frac{\beta_{B,A}}{\beta_{B,B}}$

If, moreover, we assume that Airbus and Boeing's orders are of similar sizes, then the price reaction of the company to its own orders should be symmetrical to that observed for its competitor's orders, and one obtains:

H4 : $\beta_{A,A} = -\beta_{A,B}$ **and** $\beta_{B,B} = -\beta_{B,A}$

If, in place of the preceding hypothesis, one assumes that Airbus and Boeing have identical marginal profits, one obtains:

H5 : $\beta_{A,A} = -\beta_{B,A}$ **and** $\beta_{B,B} = -\beta_{A,B}$

And finally, by combining hypotheses 4 and 5, one obtains the strongest restriction in hypothesis 6, where one deduces:

H6 : $\beta_{A,A} = -\beta_{A,B} = \beta_{B,B} = -\beta_{B,A}$

To summarize, we assume that the valuation of effects linked to a new order announcement by an airplane maker (competitor) is positive (negative) and increases (decreases) according to the size of the order. We also test the symmetry of the impact of orders on the shares of the company concerned and on those of its competitor, with as the most restrictive hypothesis that all the coefficients linked to the size of an order are equal in absolute value.

3. Methodology

The study of the impact of events on share prices goes back to the work of Fama et al. (1969), and the numerous subsequent developments have been summarized by, notably, McKinlay (1997), Binder (1998) and Khotari and Warner (2006). This methodology requires one to follow a number of steps: the definition of the events and the dates when they took place, the collection of stock market data on the companies concerned, the calculation of the impact generated by the event and the statistical verification of its significance.

3.1. The definition of events

The events studied concern the new order announcements of Airbus and Boeing.

We chose as our source of information on new airplane orders the Wall Street Journal, a reference newspaper in finance for event studies. The research was undertaken using the Factiva database crossed with the websites of EADS and Boeing, and it required the verification of over 700 press articles running from 1 July 2000 to 31 December 2005. Particular care was taken to identify the date when the order was first announced. Indeed, order information is often taken up again several days later in subsequent articles. By adopting the semi-strong efficient financial market hypothesis, one can assume that the market will react to the first announcement (new information) but will not react if the same information is announced again at a later date.

3.2. The calculation of abnormal returns

The first step in measuring the impact of an event is to build a model that enables one to assess the rates of return that one would observe in the absence of an event, that is to say the “normal” rates of return. We have decided to use the market model[4] defined by Sharpe (1963), recommended for its robustness in short-term event studies (Brown and Warner, 1995).

Market model: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$

where $R_{i,t}$ is the rate of return of company i observed on day t, $R_{m,t}$ is a market index, α_i and β_i are the parameters estimated using the least squares method and $\varepsilon_{i,t}$ are the residuals of the model.

The abnormal returns are calculated for the event window by obtaining the difference between the observed return and the “normal” return estimated by the market model.

$$RA_{i,t} = R_{i,t} - \hat{R}_{i,t}$$

where $RA_{i,t}$ is the measure of the abnormal rate of return of company i on day t, $R_{i,t}$ the observed rate of return of firm i on day t, and $\hat{R}_{i,t}$ the estimate of the “normal” rate of return using the market model.

For Boeing, we have selected the S&P 500 as the most relevant market index, and for EADS we chose the European index DJ STOXX 50. We estimated the regression parameters over a period of 90[5] trading days, with the estimation window closing 2 days before the event date.

We chose an event window of 3 days around the announcement date and then performed our tests on the cumulative abnormal returns over these 3 days. Indeed, given the very high volumes of trading in EADS and Boeing shares, we believe there is no “post-announcement” time-lag; in other words, there is no delayed market reaction. In contrast, the possibility of

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[4] We also calculated the abnormal returns using the market index method. As the results were largely identical, we will only present those obtained using the market model. We could have used other methods for estimating abnormal returns, but over such a small event window, the estimated returns constitute only a small part of the observed variance in returns. Thus, the precision of the model chosen has little influence on the results.

[5] Generally the estimation window is broader, but given our relatively short period of study (due to the fact that EADS has only been listed since July 2000) we have reduced this window in order to avoid losing too much data concerning new order announcements.

“leaks” about new orders (which would constitute a “pre-announcement” effect) poses greater problems[6]. This is why we were very careful to identify the date of the first announcement of a new order in the Wall Street Journal, as described in the preceding section.

For each new order announcement date of Airbus or Boeing, the cumulative abnormal returns were first calculated as a percentage (CAR_A for EADS and CAR_B for Boeing) and then in US dollars, by multiplying the cumulative abnormal returns around the announcement date by the market capitalization of EADS ($DCAR_A$) and BOEING ($DCAR_B$) expressed in dollars. We then tested the significance of the abnormal returns and verified whether on average they were significantly different from 0, which would thereby highlight the impact of the announcements. We used 3 different approaches: Student’s t-test, the binomial test and a bootstrap methodology.

3.3. The model for testing hypotheses H2 to H6

We use a model that enables us to study the EADS and Boeing share price reaction to new order announcements concerning the two airplane makers simultaneously, or one or the other of them. A characteristic important to take into account is the size of the order. As the terms of the deal are rarely made public, we use the number of seats to quantify the size of the order.

In order to facilitate the resolution of the tests and especially the calculation of the variance-covariance matrix of the parameters tested, we have rewritten our model in such a way as to manipulate only one equation[7]:

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[6] We also verified that the date of the announcement appeared in the same event window in other newspapers (les Echos, la Tribune, the Financial Times).

[7] We could have used a SUR-type methodology (Seemingly Unrelated Regression). $\begin{cases} DCAR_A = \beta_{A,A}X_A + \beta_{A,B}X_B + \alpha_A + \varepsilon_A \\ DCAR_B = \beta_{B,A}X_A + \beta_{B,B}X_B + \alpha_B + \varepsilon_B \end{cases}$

It enables one to take into account a possible correlation between the residuals ε_A and ε_B of the two models, especially if one assumes that the cumulative abnormal returns of one of the two companies provide the market with information and thereby act on the cumulative abnormal returns of the second company. It also facilitates the test of joint hypotheses. However, the case studied here is a particular case of the SUR model [cf. Zellner, 1962) and Dwivedi and Srivastava (1978)]. Indeed, the explanatory variables are the same for each of the two equations. This comes down to independently testing two linear regressions by ordinary least squares. We also verified the absence of a correlation between ε_A and ε_B by independently calculating the parameters of the two equations and by studying the linear correlation between the residuals of the two models. Moreover, we have taken note of the presence of a few “atypical” observations (very high residuals or a high Cook statistic) that

$$\underset{2n*1}{\begin{bmatrix} DCAR_A \\ DCAR_B \end{bmatrix}} = \underset{2n*2n}{\begin{bmatrix} I_n & 0_n \\ 0_n & I_n \end{bmatrix}} \underset{2n*1}{\begin{bmatrix} Un_A \\ Un_B \end{bmatrix}} + \underset{2n*4}{\begin{bmatrix} X_A & X_B & 0 & 0 \\ 0 & 0 & X_A & X_B \end{bmatrix}} \underset{4*1}{\begin{bmatrix} \beta_{A,A} \\ \beta_{A,B} \\ \beta_{B,A} \\ \beta_{B,B} \end{bmatrix}} + \underset{2n*1}{\varepsilon}$$

Notations:

$DCAR_A$ ($DCAR_B$) : the cumulative abnormal returns (3 days around the announcement date), expressed in US dollars, benefiting Airbus (Boeing) shareholders

$\beta_{A,A}$ ($\beta_{A,B}$) : measures the sensitivity of the EADS share price to AIRBUS (BOEING) orders

$\beta_{B,A}$ ($\beta_{B,B}$) : measures the sensitivity of the Boeing share price to AIRBUS (BOEING) orders

X_A (X_B) : size of Airbus (Boeing) order expressed in number of seats

I_n : identity matrix $n*n$

0_n : $n*n$ matrix containing only 0

Un_A (Un_B) : column vector composed of 1

n : number of days with an order (Airbus, Boeing or both)

4. Description of data

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have considerable impact on the calculation of the parameters of the model. In order to minimize their impact, it seems to us more appropriate to use a "robust" regression model (M-estimation, Hubler method).

[Table 1]

The sector of large (over 100 seats) airplane makers has been a pure duopoly since the merger in 1997 of Boeing and McDonnell-Douglas. More recently, following a restructuring of the European aerospace industry, Airbus is 80% owned by EADS and 20% by British Aerospace, with EADS being listed on the Euronext stock market since July 2000. The prior history of passenger airplane makers is provided in Lynn (1995), while Aktas et al. (2006) tell the story of the creation of EADS.

Table 1 presents key data on EADS and Boeing. The two companies are of similar size as regards the commercial aircraft activity, and it is important to note that over the period of study their sales of airplanes were equivalent.

[Table 2]

As already mentioned above, we chose the Wall Street Journal, the reference newspaper in finance for event studies, as the source of information on new airplane sales announcements (the search was conducted using the Factiva database). Particular care was taken to identify the date when the order was first announced; indeed, this information is often taken up again by different journalists in various articles). The statistics on orders are presented in Table 2. There are 40 dates with Airbus order announcements, 56 days with Boeing order announcements, and 8 days when the two companies made an announcement the same day. Most announcements are for firm orders. We notice that European airlines order mainly from Airbus and that orders from non-European companies are divided more or less equally between the two airplane makers. In connection with the anecdotal example mentioned above, this suggests that it is not easy to predict which manufacturer will win a given order. Thus, even when demand is known with certainty, airplane makers' new order announcements still have a high informational content.

5. Results

Before proceeding to the study of the reactions of EADS and Boeing shareholders to new order announcements, the following remark must be taken into account: competition between Airbus and Boeing is very strong. Nevertheless, it is possible that it is weakened by the fact that shareholders who hold stakes in both Airbus and Boeing express their preference by maximizing the sum of the market value of the two competitors (Hansen and Lott, 1996). For example, Hansen and Lott (p.50) report that "534 institutions owned shares in the same two head-to-head competitors, Intel and Motorola. For these institutions, $13.4 billion was invested in Intel (50.6 percent of Intel's market value) and $16 billion in Motorola (47 percent of its market value)". However, as only 34% of EADS shares circulate in the market (the rest of the capital is held by partner institutions), the holding of Boeing and EADS shares in common is probably not very significant.

[Table 3]

Table 3 shows the effect on shareholder value of new order announcements for the particular airplane maker and its competitor.

We performed 3 types of test (Student's t-test, bootstrap test, sign test) in order to verify whether the impact on shareholder value was significantly positive, negative or null according to the expected reaction. These tests address the cumulative abnormal returns (with a window of 3 days around the announcement date) and the cumulative abnormal returns expressed in dollars.

We notice that Airbus' orders have a significantly positive effect (+ 0.89% for the cumulative abnormal returns, or about + $12 million on average) on the shares of the parent company EADS and a significantly negative effect on the shares of its competitor Boeing (-0.68%, or about – $40 million on average).

Boeing's orders seem to be interpreted differently by the market: if the sign of the cumulative abnormal returns is in the direction expected (positive for Boeing and negative for EADS), the Student's t-test and the bootstrap test are not significant for a reasonable level of risk.

Only the binomial test shows us that we have significantly higher positive than negative cumulative abnormal returns for Boeing (0.59% versus 0.41%) and significantly higher negative than positive ones for EADS (0.61% versus 0.49%).

This absence of significance may possibly be explained by the insufficient size of our sample, as the presence of atypical observations (very low or very high cumulative abnormal returns) could indicate possible strategic effects.

It is more difficult to interpret the effects linked to simultaneous new order announcements by Airbus and Boeing, since we have very few observations. The trend would seem to be a positive impact on shareholder value for both companies.

[Table 4]

Table 4 enables one to study the impact of the size of the order on the market capitalization of the seller and its competitor.

We used a robust regression model (M-estimation, Hubler method) in order to minimize the impact of possible atypical observations.

As already mentioned above, since the details of the value of orders are often not known, we approximate the size of the order by the number of seats corresponding to the standard configuration of the airplanes ordered.

We accept at a risk of 5% $\beta_{AA} > 0$, $\beta_{BB} > 0$ and $\beta_{BA} < 0$ but $\beta_{A,B}$ is not significantly different from 0.

We can conclude that for both companies the impact of new orders is positive for the firm: an additional seat ordered from Airbus increases on average the market value of EADS by some $2,600, and an additional seat ordered from Boeing increases the market value of Boeing by some $3,100.

We also observe a significantly negative impact of Airbus' orders on the Boeing share price: on average, an additional seat ordered from Airbus brings about a $4,200 drop in Boeing's market capitalization. The reciprocal effect in not observed: a Boeing order does not seem to have a significant impact on the value of EADS.

These first results thus partially validate H2.[8]

[Table 5]

Table 5 summarizes the results from hypotheses H3 to H6, and enables one to study the impact of the size of the order on the market capitalization of the seller and its competitor.

All hypotheses are accepted. It would seem, therefore, that the market reacts significantly to new order announcements and that this reaction is symmetrical between the company concerned and its competitor. An Airbus order, for example, will on average have a positive impact on the value of EADS and a negative impact of similar size on the value of Boeing; this impact on Airbus will also be similar in absolute value to that on Airbus in the case of a Boeing order.

6. Discussion

Our series of hypotheses where each order implies profits for the seller and a loss of earnings (foregone revenue) for its competitor can be linked to a simple Cournot model. In this case, hypotheses 5 and 6 require an additional restriction: the cost structure of the two competitors must be symmetrical. An implicit supplementary hypothesis is that new order announcements are not anticipated and have no informational content on future demand.

[8] In order to obtain a more detailed picture of the impact of orders for large airplanes, we also studied the effects of Boeing orders between 1962 and 1997 on the share price of McDonnell and then, after the merger of the two companies, of McDonnell-Douglas. We found that the impact on the McDonnell share price is not significant; in contrast, it is significantly positive for Boeing shares. This shows that the nature of competition and/or the dissemination of information on the passenger airplane market has evolved.

We will now briefly discuss the following point: how can the expected market reaction be different under various sets of hypotheses?

First of all, strategic considerations lead one to think that the impact of a new order on the share price may derive less from its direct effect on profits than from its future effects via the expected reaction of its competitor to this event. One can refer to the effect of big orders (such as those, already mentioned, of China Airlines and EasyJet). Such elements can work against the positive linear relation between order size and the effect on the share price of the companies in the sector[9].

Next, assume that it is a Bertrand model and not a Cournot model that applies to our case[10]. The units produced will then be valued at their marginal cost, and therefore all the market reactions would be zero on average.

Thirdly, what would happen if the new orders were largely anticipated? The impact of orders on profitability in the event period would then only partially be reflected. Thus the rates of return and the cross-sectional regression coefficients should be smaller in magnitude (and also a fortiori the regression coefficients, if the biggest orders are more easily anticipated).

Finally, let us consider what could happen if most of the informational content of a new order announcement concerned the future conditions in the sector rather than the order itself. The news regarding the sector could drown the effect specific to the firm, further reducing the power of our statistical tests. This factor, however, creates a supplementary possibility. The "marginal investor" (whose decisions determine the market reactions we are studying) may be inclined to buy and sell shares of the two airplane makers at the same time (which relates to

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[9] Such effects can pose a real challenge to investors not familiar with the sector (who perhaps do not know the cost structure of the industry, for example) in correctly valuing the airplane maker.

[10] At first sight, this assumption seems less appropriate since production in this sector is more difficult to adjust than prices. On the other hand, sometimes orders have been registered several years earlier and thus airplanes are built in direct response to demand. Irwin and Pavcnik (2001) consider that both the Cournot and Bertrand models could be used for the Airbus-Boeing case.

the argument of Hansen and Lott (1996) discussed above). In this case, the distinct reactions of the two competitors to new order announcements would be more difficult to detect.

Our data, unfortunately, do not allow us to choose one rather than another of these hypotheses. The factors mentioned above are probably all relevant to some extent. However, we find it very instructive that, with a sample of about 100 orders and a sector that is structured as a simple duopoly, the market reactions can be so difficult to interpret. Thus the interpretations made by journalists and by those who specialize in commenting on share price movements following a particular event seem to be very simplistic.

7. Conclusion

In this article, we study the duopolistic competition between Airbus and Boeing by examining the valuation of their shares by the stock market. This research is the first, to our knowledge, to make the direct link between individual sales and market capitalization. Our results show that new order announcements benefit the seller more than its competitor, and that there is a certain symmetry in the impact of new order announcements on the company concerned and on its competitor. However, this impact is on average not very strong, at least not as strong as analysts often claim when they comment on a company registering a new order. It nevertheless remains true that these announcements bring about a revaluation of the companies concerned (via the revaluation of expected cash flows), which indicates that strategic considerations do not seem to be so important, or at least that their influence is in line with the direction expected by our hypotheses.

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Appendices

Table 1: Descriptive statistics for EADS and Boeing

	EADS				
	2005	2004	2003	2002	2001
Market cap (end of year), in 10^9 €	26.13	17.20	15.30	8.00	11.00
Turnover, in 10^9 €	34.20	31.80	30.10	29.90	30.80
Airbus sales, in 10^9 €	22.20	20.20	19.00	19.50	20.50
EBIT Airbus, in 10^9 €	2.80	2.40	1.50	1.40	1.70
Deliveries	378	320	305	303	325
Gross orders (*)	1111	370	284	300	375
Net orders (**)	1055	366	254	233	274
Number of shares (in millions)	816.5	809.6	812.9	811.2	807.2
Share price (end of year)	€ 31.90	€ 21.40	€ 18.90	€ 9.90	€ 13.60

	BOEING				
	2005	2004	2003	2002	2001
Market cap (end of year), in 10 9 €	56.70	43.40	33.70	26.40	30.90
Turnover, in 10 9 €	54.80	52.40	50.30	53.80	58.00
Turnover from sales of commercial aircraft in 10 9 €	22.60	21.00	22.40	28.40	35.10
EBIT Boeing, in 10 9 €	2.60	1.90	0.70	2.00	1.90
Deliveries	290	285	281	381	527
Gross orders	1028	277	250	251	328
Net orders	1002	272	240	176	272
Number of shares (in millions)	807.3	839.6	800.2	799.3	798
Share price (end of year)	$ 70.20	$ 51.70	42.10 $	33.0 $	38.8 $

Source: EADS and Boeing annual reports

(*) gross orders do not take into account cancellations or conversions

(**) net orders are corrected for cancellations and conversions

Table 2: Characteristics of orders

	AIRBUS		BOEING
Number of events (*)			
when one firm announces	48		64
when both firms announce		8	
Size of the order (n^o of airplanes)			
minimum	3		1
maximum	111		100
average	25		18
median	16		10
total	1184		1173
Size of the order (n^o of seats)			
minimum	415		298
maximum	24 192		21 120
average	5 808		4 741
median	4 605		3 238
total	278 774		303 452

(*) Number of days when an order was registered between November 2000 and December 2005.

There can be one or several airline companies that announce an order on a given day. In this case the orders were aggregated by day: if two airlines announced orders on the same day, we considered it a single event and one aggregated order.

Table 3: Market reaction to announcements by an airplane maker and its competitor

Student's t-test

			EADS reaction					BOEING reaction			
Type of event	N		PCAR	p-value	DCAR	p-value		PCAR	p-value	DCAR	p-value
Airbus orders only	40	(u)	0.89	0.02	$12 091 602	0.02	(u)	-0.68	0.09	-$39 907 037	0.04
Boeing orders only	56	(u)	-0.39	0.21	-$4 781 703	0.27	(u)	0.41	0.15	$13 760 608	0.22
Airbus and Boeing orders	8	(b)	0.42	0.25	$9 254 436	0.33	(b)	1.81	0.11	$84 799 649	0.13

(u) unilateral test
(b) bilateral test

Note:
PCAR is the cumulative abnormal return over the period (-1;+1) around the announcement date.
DCAR is the corresponding cumulative abnormal return in dollars. For EADS, we multiplied the cumulative abnormal return in euros by the euro-dollar exchange rate for the period under study.

Binomial test: proportions test at 50%

		EADS reaction					BOEING reaction				
Type of event	N	p(*)	PCAR	p-value	DCAR	p-value	p(*)	PCAR	p-value	DCAR	p-value
Airbus orders only	40	>0	0.58	0.21	0.58	0.21	<0	0.55	0.32	0.55	0.32
Boeing orders only	56	<0	0.61	0.07	0.61	0.07	>0	0.59	0.12	0.59	0.12
Airbus and Boeing orders	8	>0	0.63	0.73	0.63	0.73	>0	0.75	0.29	0.75	0.29

(*) p is the proportion of PCAR (DCAR) that is strictly positive (>0) or strictly negative (<0)

Bootstrap test (*)[11]

Type of event	N		EADS reaction PCAR	t	t*(5%)	t*(10%)	DCAR	t	t*(5%)	t*(10%)
Airbus orders only	40	(u)	0.89	2.16	1.76	1.33	$ 12 091 602.26	2.10	1.76	1.39
Boeing orders only	56	(u)	-0.39	-0.82	1.67	1.22	$ -4 781 703.41	-0.61	1.67	1.31
Airbus and Boeing orders	8	(b)	0.42	0.73	1.83	1.55	$ 9 254 435.58	1.06	1.90	1.59

(u) unilateral test
(b) bilateral test

Type of event	N		BOEING reaction PCAR	t	t*(5%)	t*(10%)	DCAR	t	t*(5%)	t*(10%)
Airbus orders only	40	(u)	-0.69	-1.39	1.68	1.28	$ -39 907 037.36	-1.84	1.54	1.22
Boeing orders only	56	(u)	0.42	1.05	1.65	1.34	$ 13 760 608.94	0.79	1.53	1.22
Airbus and Boeing orders	8	(b)	1.82	1.84	1.65	1.45	$ 84 799 648.90	1.69	1.73	1.46

(u) unilateral test
(b) bilateral test

[11] For a given type of event, given X1, X2, …, Xn a sample of PCAR (DCAR) that we assume are i.i.d. according to the unknown distribution function F, of the average µ. $F(x) = G(x-\mu)$.

We want to test: $H_0 : \mu = 0$ against $H_1 : \mu > 0$ (or $H_1 : \mu < 0$).

We estimate the function G by G_n the distribution function $\{X_i - \overline{X}_n, i = 1,...,n\}$ with $\overline{X}_n = \sum_{i=1}^{n} X_i / n$.
The critical region of the test is of the form:

$T_n(X_1, X_2,..., X_n) \geq \hat{c}_n$ où $T_n(X_1, X_2,..., X_n) = \sqrt{n}\,\frac{1}{\hat{\sigma}}(\overline{X}_n - 0)$, avec $\hat{\sigma} = \sum_{i=1}^{n}(X_i - \overline{X}_n)^2/(n-1)$.

The calculation of $\hat{c}_n$ is done by bootstrap. We create B bootstrap samples of size n $G_{n,b}(X_i - 0)$, b=1,…,B, to approximate the empirical distribution of X1, X2, …, Xn.

For each sample b, we calculate $T_{nb}(X^*_{1,b}, X^*_{2,b},..., X^*_{n,b})$. Now, as the B series $T_{nb}(X^*_{1,b}, X^*_{2,b},..., X^*_{n,b})$ is given in ascending order, $\hat{c}_n$ is approached by the $((1-\alpha)B+1)th$ value of $T_{nb}(X^*_{1,b}, X^*_{2,b},..., X^*_{n,b})$.

For example, for B=1000 and □=5%, $\hat{c}_n = (0.95 \times 1000 + 1)th$ value of $T_{nb}(X^*_{1,b}, X^*_{2,b},..., X^*_{n,b})$.

Table 4. Regression on the cumulative abnormal returns (cumulative abnormal returns in dollars) according to the size of the order

Robust regression model (M-estimation, Hubler method)

	EADS reaction				BOEING reaction			
	coeff.	t	p-value bilater.	p-value unilater.	coeff.	t	p-value bilater.	p-value unilater.
Constant	-5 896 965	-0.61	54%	27%	10 079 050	1.05	30%	15%
Airbus orders	(β_{AA}) 2 593	1.71	9%	4%	(β_{BA}) -4 236	-2.79	1%	0%
Boeing orders	(β_{AB}) -377	-0.24	81%	41%	(β_{BB}) 3 142	1.98	5%	2%
Observations	208							
R^2	0.056							
p-value Test F	0.002							

Table 5. Results for hypotheses H3 to H6

H3 : $\frac{\beta_{A,A}}{\beta_{A,B}} = \frac{\beta_{B,A}}{\beta_{B,B}}$

As H3 is non linear, we used two different methodologies to test it:

- Taylor development[12]

Parameters	$\hat{\beta} = \beta_{A,A}.\beta_{B,B} - \beta_{B,A..}\beta_{A,B}$	$V(\hat{\beta})$	t	P.value
Values	6 546 283	1.07e+14	0.6325	0.527

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[12] We note $\beta = \beta_{A,A}\beta_{B,B} - \beta_{B,A}\beta_{B,A} = f(\beta_{A,A}, \beta_{B,B}, \beta_{A,B}, \beta_{B,A})$

Let $\hat{\beta}$ be the estimator of β .

$\hat{\beta} = f(\hat{\beta}_{A,A}, \hat{\beta}_{B,B}, \hat{\beta}_{A,B}, \hat{\beta}_{B,A})$

To facilitate the writing, we note

$\hat{\beta}_{A,A} = X_1, \hat{\beta}_{B,B} = X_2, \hat{\beta}_{A,B} = X_3, \hat{\beta}_{B,A} = X_4$. $\hat{\beta} = f(X_1, X_2, X_3, X_4) = X_1X_4 - X_3X_4$

Let β_0 be the value f at the point ($E(\hat{\beta}_{A,A}), E(\hat{\beta}_{B,B}), E(\hat{\beta}_{A,B}), E(\hat{\beta}_{B,A})$) noted ($X^0{}_1, X^0{}_2, X_3{}^0, X_4{}^0$).

By applying the Taylor development of the function f around the real value of the point β ,

$$\hat{\beta} = f(X_1, X_2, X_3, X_4) \approx f(X^0{}_1, X^0{}_2, X_3{}^0, X_4{}^0) + (X_1 - X_1^0)\frac{\delta f}{\delta x_1}\left|X^0\right|$$

$$X_0 \qquad + (X_2 - X_2^0)\frac{\delta f}{\delta x_2}\left|X^0\right|$$

$$+ (X_3 - X_3^0)\frac{\delta f}{\delta x_3}\left|X^0\right|$$

$$+ (X_4 - X_4^0)\frac{\delta f}{\delta x_4}\left|X^0\right|$$

And $f(X^0{}_1, X^0{}_2, X_3{}^0, X_4{}^0) = \beta$, given the properties of the estimators without bias

We note $X = \begin{bmatrix} X_1 & X_2 & X_3 & X_4 \end{bmatrix}'$ and $A = \begin{bmatrix} \frac{\delta f}{\delta x_1} & \frac{\delta f}{\delta x_2} & \frac{\delta f}{\delta x_3} & \frac{\delta f}{\delta x_4} \end{bmatrix}' = \begin{bmatrix} X_2 & X_1 & -X_4 & -X_3 \end{bmatrix}$

$V(\hat{\beta}) = V(A.X) = A'.V(X).A$ and $.V(X)$ is the matrix of the variance-covariance of the coefficients of the regression $(\hat{\beta}_{A,A}, \hat{\beta}_{B,B}, \hat{\beta}_{A,B}, \hat{\beta}_{B,A})$.

- Bootstrap (bootstrap estimation of the distribution of $\beta_{A,A}.\beta_{B,B} - \beta_{B,A}.\beta_{A,B}$ then calculation of the percentile confidence intervals)

Confidence interval at 95%		Confidence interval at 90%	
Lower bound	Upper bound	Lower bound	Upper bound
-13 447 051	29 586 779	-9 224 899	26 238 027

Hypotheses H4 to H6

Hypotheses	Wald Statistic	p.value
$H4:\begin{cases}\beta_{A,A} = -\beta_{A,B} \\ \beta_{B,B} = -\beta_{B,A}\end{cases}$	0.9611	0.6185
$H5:\begin{cases}\beta_{A,A} = -\beta_{B,A} \\ \beta_{B,B} = -\beta_{A,B}\end{cases}$	2.99	0.2238
$H6: \beta_{A,A} = -\beta_{A,B} = \beta_{B,B} = -\beta_{B,A}$	3.8562	0.2774