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Airline cost changes: To what extent are they passed through to the passenger?

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ABSTRACT

Since the start of the Millennium airline costs have been highly volatile, mainly due to large fluctuations in jet fuel prices. An important question for airlines and regulators is whether airlines are able to pass through cost changes to their prices. Little empirical evidence on the pass-through of costs exists. In this paper, we investigate which pass-through rates are most likely. According to economic theory, the pass-through of costs depends strongly on the type of cost increase (firm-specific or sector-wide) and market conditions (monopoly, oligopoly, perfect competition). In monopolistic markets, the shape of the demand curve also matters (linear, constant elasticity, log, power function). A pass-through rate of 100% is often assumed based on the reasoning that the aviation sector is highly competitive. We analyse market concentration in all airline markets in the world, and generally find a high level of concentration. Additionally, different airlines offer different products based on a variety of factors, including service, flight frequency, legroom, bags allowed on board, flight time and transfer time. Therefore, most aviation markets can be characterised as differentiated oligopolies. As airlines choose their quantities first (flight schedules) and adapt their prices to demand (yield management), we consider the Cournot model the best choice. In such markets, firmspecific cost changes will be passed through by a rate of less than half while sector-wide cost changes are passed through by a rate of more than half. In specific situations, the pass-through rate may be different. Examples are limited airport capacity (congestion), cross-subsidization, and the extent to which there is a level playing field.

1. Introduction

Airline costs may change for various reasons, such as alternations in input prices, labour conditions, taxation regimes and airport charges. The main cost source for airlines are fuel costs. In 2014 fuel costs represented around 20–50% of total costs, depending on the type of airline (see Table 1). The price of jet fuel has shown great fluctuations over the past 15 years. At the start of the millennium, one barrel of jet fuel cost $33 (see Fig. 1). By the summer of 2008 prices had increased five-fold to $163. Then the financial crisis hit causing a sharp price decline; by the end of 2008 a barrel of jet fuel cost $58. The subsequent economic recovery and the improving political situation in the Middle East led to a strong recovery, with jet fuel prices averaging at around $120 per barrel between 2011 and 2014. Since 2014, prices have decreased sharply due to overcapacity in the market.

Volatility in cost levels implies risk to the airline operation, especially when higher costs cannot be passed through to the passenger. The pass-through rate is not only relevant for airlines, but also for airports, policy makers and researchers. The impacts of a policy measure, such as a charge or tax increase, depend to what extent the cost increase is passed through to the passenger. When cost increases can be passed through for 100%, they are fully borne by an airline's passengers. However, the airline itself may also be affected. A full pass-through leads to higher fares, which will – depending on the elasticity of demand – result in lower sales. Furthermore, when an airline's competitors do not raise their fares, the airline's market share, sales and profits fall. If, on the other hand, the cost increase is not passed through to the passenger, the volume of demand remains the same, but profits of the airline will be negatively affected.

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Table 1
Cost distribution for various airlines.

Cost component	Ryanair	easyJet	Lufthansa	Delta airlines	Singapore airlines	Emirates
Fuel	46%	32%	21%	31%	39%	35%
Staff	11%	12%	23%	21%	13%	14%
Maintenance	3%	5%	3%	5%	5%	3%
Depreciation & amortisation	8%	3%	5%	5%	11%	9%
Airport & ATC Charges	26%	28%	17%	4%	5%	2%
Other	7%	20%	31%	35%	27%	37%
Total	100%	100%	100%	100%	100%	100%

Source: Annual reports of easyJet, Lufthansa and Delta Airlines over 2014, Annual reports of Ryanair and Singapore Airlines for April 2013–March 2014 and the Annual report of Emirates for April 2014–March 2015.

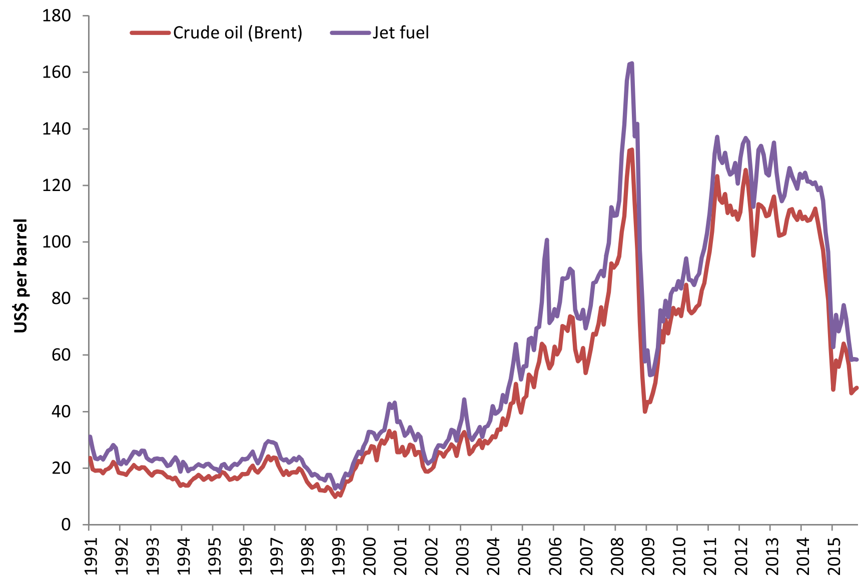

Fig. 1. Development of crude oil and jet fuel prices, 1991–2015.
Source: IEA.

There is limited empirical evidence available with respect to the pass-through of cost changes in aviation. As a result, most studies that assess the impact of cost changes *assume* a certain pass-through rate. These rates range between 0% and 100%, primarily due to differing assumptions regarding market structure. Studies that assume a full pass-through usually do so based on the assumption that aviation markets are perfectly competitive, whereas studies that assume a lower pass-through rate view aviation markets as oligopolies.

In this paper, we investigate which pass-through rates are most likely to occur in practice. The next section provides a brief overview of the literature with respect to the pass-through of cost changes in aviation. Section 3 describes current economic theory regarding the pass-through of cost changes. It shall become clear that the pass-through rate indeed depends on the type of market structure. In Section 4, we shall therefore analyse the prevailing market structures in the aviation industry by measuring market concentration in all worldwide aviation markets. This allows us to determine which pass-through rates are most likely to occur in practice. Section 5 describes special situations in which the pass-through rates might be different. Section 6 concludes.

2. Literature

There is extensive literature in a number of fields related to the pass-through of costs. Most of the existing empirical evidence addresses the pass-through of consumer fuel costs (e.g., Burdette and Zyren, 2002, 2003; Meyler, 2009), emission costs (Honkatukia et al., 2006; Sijm et al., 2006; Alexeeva-Talebi, 2010a, 2010b), exchange rates (Campa and Goldberg, 2005; Campa and González-Mínguez, 2006; Campa et al., 2005; Gust et al., 2010; Leibtag et al., 2007; Nakamura and Zerom, 2010; Yang, 1995), and interest rates (Bondt, 2002).

However, empirical evidence with respect to the pass-through rate of cost changes in the aviation industry is limited. Özmen (2009) regressed ticket prices for domestic U.S. routes against fuel prices and found that a 1% increase in fuel prices resulted in a 4% increase in fares on average. Because fares are much higher than fuel costs, this would amount to a pass-through rate of substantially more than 400% (e.g., if fuel costs are one third of fares, the pass-through rate would be 1200%), which seems rather extreme. The author notes that there are questions regarding the quality of the data used. PWC (2005) regressed UK air travel prices against kerosene prices and found that airlines (including low-cost carriers) pass on 90–105% of the increases in costs of kerosene with some delay. Duplantis (2010) and Toru (2011) also found pass-through rates close to 100%, but only during periods when higher fuel costs triggered capacity changes. When higher fuel costs did not trigger capacity changes, the pass-through rate did not statistically differ from zero. This finding is supported by Borenstein and Rose (2007), who note that airlines face difficulties in passing on fuel cost increases because in general, they are unable to make rapid changes to capacity for logistical reasons. They did not find empirical evidence that kerosene price shocks lead to capacity changes.

Because of limited empirical evidence with respect to the pass-through rate of cost changes in aviation, most studies *assume* a pass-through rate. Over the past few years, many studies have been conducted with respect to the economic effects of the introduction of ETS in aviation. These are all model studies, as no empirical evidence on the pass-through of ETS costs exists. Some of these studies (Anger and Kohler, 2010; Boon et al., 2007; European Commission, 2006; Frontier Economics, 2006; Lowe et al., 2007; Mayor and Tol, 2010; Mendes and Santos, 2008; Morrell, 2007; PWC, 2005; Scheelhaase et al., 2010; Scheelhaase and Grimme, 2007; Vivid Economics, 2007; Wit et al., 2005) assume that ETS costs are fully passed through based on the assumption that the aviation industry is highly competitive. In a situation of perfect competition, marginal prices equal marginal costs. Profits are therefore marginal, which leaves no room for airlines to absorb costs without going bankrupt.

Other studies, however, assume lower pass-through rates for ETS costs. Forsyth and Gillen (2007) and Ernst & Young and York Aviation (2007) state that a full pass-through is only likely in highly competitive markets. Because most markets can be seen as oligopolies, the actual pass-through is likely to be considerably smaller, at least in the short run. In the long run, it is likely that airlines will exit from some city pairs, and this will enable the remaining airlines to raise their fares and restore profitability. Therefore, the pass-through in oligopolies over the short run is incomplete, but it may increase over time. According to Bloomberg (2011), airlines will, on average, pass on 30% of ETS costs in the short run and 60% in the long run. Delta Airlines (2013) notes that its ability to pass through increased fuel costs depends on the competitiveness of the market. The airline has not been able to increase its fares to fully offset the effect of increased fuel costs, which implies that the markets in which Delta operates are not highly competitive.

Furthermore, Forsyth and Gillen (2007), Forsyth (2008) and Ernst & Young and York Aviation (2007), and Oxera (2003) demonstrate that in cases of constrained airport capacity, virtually no pass-through is likely to occur, as any additional costs would be borne by airlines in the form of reduced slot rents. Another reason for a pass-through rate of less than 100% might be attributable to airlines' pursuit of market share by keeping prices low and not fully passing through cost increases (Forsyth, 2008; Vivid Economics, 2007). This, however, goes against economic theory, which suggests that airlines are profit maximisers. Several studies also point out that cost changes are most likely to be passed through in markets with low price sensitivity, such as markets where the airline has market power or in the business segment (Bloomberg, 2011; Vivid Economics, 2007; Frontier Economics, 2006; Toru, 2011; Scheelhaase and Grimme, 2007).[1] Due to the lower fares of low-cost carriers (LCCs) and the higher price sensitivity of their passengers, a price increase in this segment leads to a larger demand reaction. Frontier Economics (2006) concluded that LCCs are able to pass through a smaller share of cost increases than full service carriers.

3. Pass-through in economic theory

According to economic theory, the pass-through rate of profit maximising firms depends on market structure (perfect competition, oligopoly or monopoly) and the type of cost change (firm-specific or sector-wide). Table 2 lists the pass-through rates for various combinations of these factors found in the literature. A similar overview is given by Jørgensen and Santos (2011). However, they focus on firms having other goals besides profit maximisation. The overview in this section is limited to profit maximising firms. For a general theoretical treatment of different market structures see Weyl and Fabinger (2013).

A general rule for pricing is that firms will charge a relative mark-up on marginal costs of $1/(1+1/E_d)$, in which E_d is the price elasticity of demand (Varian, 2010). If demand is elastic ($E_d < -1$), the relative mark-up will be greater than one, implying a cost pass-through of at least 100%. However, this rule assumes that E_d is a constant. For shapes of the demand curve in which E_d changes, other mark-ups apply (Bulow and Pfleiderer, 1983). Additionally, the elasticity of demand for an individual firm depends on the amount of competition. In this section, we show how pass-through varies in different market types and for different shapes of demand.

In markets characterized by *perfect competition*,[2] fierce competition drives prices down to the level of (marginal) production costs. As a consequence, profits are at a minimum level. If costs go up for all competitors, they will have to increase their price as the only viable alternative to going out of business. In these markets, the elasticity of demand for individual firms is minus infinity, implying a mark-up of 100%. This means that sector-wide cost increases will be passed on entirely to the passenger (see Table 2). If, however, costs go up for only one firm, this firm cannot raise its prices, because in all likelihood its market share would then decline to zero.

For *monopoly* markets,[3] the amount of pass-through depends on price elasticity (i.e., the shape of the demand curve): higher elasticity leads to a smaller pass-through, as shown in the mark-up formula $1/(1+1/E_d)$ above. For constant elasticity demand, the pass-through will be larger than 100%, as the firm will choose a constant relative mark-up on total costs, and therefore also on cost changes. For other shapes of the demand curve, elasticity will change as the price changes, leading to a changing mark-up and different rates of pass-through. If the demand curve is linear, 50% of cost changes will be passed through. For a log demand curve, the pass-through is 100%, and for a power demand curve it is between 0 and 100% (see Table 2).

The results for monopoly markets also apply to *monopolistic competition* markets. In these markets, each competitor supplies a somewhat different product, rendering them to some extent a monopoly. However, because competitors provide close substitutes, price elasticity may be high. In such situations, price increases by individual firms may cause a large loss in sales. In monopolistic competition markets, as in monopoly markets, opportunities for pass-through strongly depend on the shape of demand curves, as shown in Table 2. Additionally, the amount of product differentiation may vary among competitors. For instance, Huse and Oliveira (2012) demonstrate that legacy airlines and LCCs respond asymmetrically to new entrants because they offer different products. In this situation, firm-specific cost shocks may be differently passed through to passengers based upon

[1] Some argue, however, that the business segment has been exploited to the extreme and the segment is becoming more and more price elastic. Airlines are also keen to preserve their share of premium passengers because of their strong contribution to profitability (Morrell, 2009).

[2] The main assumptions in this model are many identical suppliers, a homogenous product, no economies of scale, and free access for new competitors.

[3] The assumption of a monopoly market is that there is only one supplier, which is caused, for instance, by economies of scale or government regulation.

Table 2
Pass-through in different market types, all industries.

Type of competition	Other assumptions	Pass-through	Source
Perfect competition	Firm-specific cost change	0%	Bulow and Pfleiderer (1983)
	Sector-wide cost change	100%	Zimmerman and Carlson (2010)
Monopoly, monopolistic competition	Firm-specific cost change		
	Linear demand	50%	Varian (2010)
	Constant elasticity demand curve,	$1/(1+1/E_d)$	Bulow and Pfleiderer (1983)
	E_d = price elasticity	>100% if $-\infty < E_d < -1$	
	Power demand curve	0–100%	
	Log demand curve	100%	
Oligopoly (Cournot type)	*Homogenous product*		Ten Kate and Niels (2005)
	Linear demand		
	Equal market shares		
	Firm-specific cost change (out of N firms)	$1/(N+1)$	
	Sector-wide cost change (for N firms)	$N/(N+1)$	
Oligopoly (Cournot type)	*Differentiated product*		Zimmerman and Carlson (2010)
	Firm-specific cost change	20–50%	
	Sector-wide cost change	Larger than 20–50%	
Oligopoly (Bertrand type)	*Differentiated product*		Zimmerman and Carlson (2010)
	Firm-specific cost change	0–50%	
	Sector-wide cost change	Larger than 50%[a]	

[a] This can be seen by multiplying equation (33) of Zimmerman and Carlson (2010) by n. The result can be shown to be larger than ½.

competitors' product offerings and attendant price structures. Sector-wide cost changes may also be impacted by asymmetric product differentiation.

In *oligopolistic* markets, firms may respond asymmetrically to increases and reductions in prices or quantities by competitors. This is reflected in so-called reaction curves (Varian, 2010) and leads to a focus on maintaining a firm's market share, which may be interpreted as a long-term leaning toward continuity and profitability. Another explanation for this type of asymmetric behaviour is that firms 'punish' their competitors for not sticking to a high price level. In oligopolies, collusion may take place, in which suppliers act as monopolists together and make deals to coordinate prices and/or quantities (such cartels are forbidden in many countries). Coordination may also be more implicit, with one firm acting as a leader, followed by others. The leader is often the firm with the largest market share. It sets quantities sold and/or prices charged, which are mostly followed by others. The price that firms charge before a price reduction acts as a focal point for coordination, but it is not a unique equilibrium. A consequence of this model is that when coordination breaks down, sellers immediately lower prices to the competitive level. As a result, prices must be rapidly adjusted following such a cost reduction when oligopolistic coordination fails (Borenstein et al., 1997).

In oligopolies, we see partial pass-through in Table 2. Ten Kate and Niels (2005) derive exact rates of pass-through, which depend on the number of competitors, but their assumptions (homogenous product, linear demand, equal-size firms) are rather restrictive and are not applicable to airlines. In the cases presented by Zimmerman and Carlson (2010) (differentiated product, firms may have unequal market shares), the results are less clear-cut, but some general observations can be made. In Cournot oligopolies (firms choose quantities), the pass-through rate of firm-specific cost changes is 50% for a monopoly, which becomes lower if the number of competitors goes up and rises to approximately 50% after hitting a critical minimum value of about 20%. In Bertrand oligopolies (firms choose prices), the pass-through rate of firm-specific cost changes is also initially 50% for a monopoly, but always falls if the number of competitors is higher. If the cost increase is sector-wide, a relatively large portion of the cost is passed through. Unfortunately, these models all assume linear demand curves, which seems rather restrictive.

Some criticise the assumption of oligopolistic (or monopolistic) competition between airlines, as this would mean that price setting is above marginal costs (Bloomberg, 2011; PWC, 2005). This would imply that airlines are making excessive profits, whereas profit margins in the aviation industry appear low over the long-term. There are various explanations for profit margins to be low, even under oligopolistic (or monopolistic) competition:

- *Rents are used by legacy airlines to cover high employment costs*. Newer airlines not affected by generous financial schemes for their employees are profitable. Ryanair's net margin has been around 12% for the last two years (Ryanair, 2013). The net margin for easyJet was on average 8% over the last two years (easyJet, 2013).
- *There is overcapacity during economic downturns*. This leads to relatively high costs and low revenues, leaving little or no profit. Airlines such as Ryanair overcome this by ordering aircraft at the bottom of the economic cycle, when prices are low (Christie, 2012), thus ensuring new capacity when the economy revives.
- *There is fear of market entry by competitors*. Market entry by a new airline generally results in overcapacity and reduced load factors for incumbents. The incumbents may choose not to incur the full rent to make it less attractive for competitors to enter the market.

Economic theory demonstrates that the amount of pass-through largely depends on the type of cost increase and on market structure. Sector-wide cost increases will be passed through to a large extent, but not necessarily exactly 100%. Depending on market structure, the pass-through rate may be smaller or larger than 100%. Firm-specific cost increases will generally be passed on to a relatively small extent.

4. Prevailing market structures in the aviation industry

To determine which pass-through rates are most likely to occur in practice, we must determine what market structures are most prevalent in the industry. In this section, we estimate the concentration level for each aviation market in the world. Concentration levels can be measured in various ways. The most straightforward method is by counting the number of competitors in a market. Intuitively, a higher number of competitors is associated with increased competition. However, this indicator does not take into account the market shares of various competitors. In aviation markets, especially the long-haul markets, passengers can generally choose from many direct and indirect flight alternatives. When available, passengers prefer direct flights due to the shorter travel time involved. Indirect alternatives are only attractive in the absence of direct flights or when the increase in travel time is compensated for by a lower ticket price. Most indirect alternatives offered are relatively unattractive to the passenger and will capture only a small share of the market. One should therefore be cautious in looking solely at the number of competitors in a market.

The most frequently used concentration index that does take the market shares of individual competitors into account is the Herfindahl-Hirschman Index (HHI) (Reynolds-Feighan, 1998; Alderghi et al., 2012). The HHI is calculated by summing the squared market shares of competing travel alternatives:

$$HHI_{x,y} = \sum_{a} Market\ share_{x,y,a}{}^{2} \tag{1}$$

where:

$HHI_{x,y}$: HHI in the market between airport (system) x and airport (system) y.
$Marketshare_{x,y,a}$: Market share of airline/alliance a in the market between airport (system) x and airport (system) y.

The HHI is sensitive to the incorrect measurement of market shares. Because it involves squared market shares, any measurement error will also be squared. A correct measurement of the market shares depends to a large extent on a correct definition of relevant markets (Lijesen, 2004).

We analysed the number of competitors as well as the HHIs for each aviation market in the world using MIDT passenger data for 2010. Aviation markets are defined as airport pairs. However, when an airport belongs to a multi-airport system, all airports within the system are assumed to serve the same market. This means, for instance, that the market between London and New York consists of all air links between London airports and New York airports. In other words, it is assumed that all airlines operating from airports within a multi-airport system and offering service to a certain destination are competitors. This assumption corresponds to the findings of Dresner et al. (1996), Morrison (2001), Vowles (2001), and Brueckner et al. (2013), who demonstrate that air fares on an airport pair decrease not only when competition on the airport pair itself is increased, but also when competition from adjacent airports increases. If competition from adjacent airports within the same airport region is not taken into account, one tends to underestimate the actual competition level as well as the number of competitors serving the market. Appendix A provides an overview of the multi-airport systems included in the analysis.

For each market, we calculated airline market shares. We assumed that alliance partners do not compete with one another; therefore, these have been considered together.[4] When counting the number of competitors in each market, we excluded airlines with less than 5% market share. This was done to overcome the problem mentioned above with respect to the fact that in long-haul markets, there may be many competitors with very small market shares. However, when computing the HHI, we included competitors with small market shares. Because each market share is squared in the calculation of the HHI, very small market shares hardly influence its value.

It is generally assumed that an HHI of below 1000 represents a competitive market. An HHI between 1000 and 1800 points to a moderately concentrated market, whereas an HHI of over 1800 represents a highly concentrated market. Table 3 reveals that the majority of the aviation markets have an HHI of over 1800. Only 1% of the markets have an HHI below 1800. Around 2% of the passengers travel in these markets. The average HHI is over 4600. Not surprisingly, the number of competitors is highest in the most competitive markets. In highly concentrated markets with an HHI of over 1,800, the average number of competitors is just above 3.

Market concentration appears to be higher for business class passengers than for economy class passengers (Table 4). On average, business class passengers have fewer competing airlines to choose from than economy class passengers. This is because many airlines no longer offer business class seats, especially on short-haul routes.

Table 5 demonstrates that more than half of the aviation markets are in fact monopolies. These markets are rather small in size, with only 10% passengers travelling in these monopolised markets. Most passengers (around 75%) travel in markets that appear to be oligopolies, with two to four competing airlines/alliances.

The high degree of concentration may have many causes. First, supply has a minimum size (a small airplane on a low-frequency connection). If demand on many connections is small, it may not be viable to have more than one or a few airlines in these connections. Additionally, entry barriers exist in many places, such as limited landing rights or airport slots. Such barriers may prevent new entrants from increasing competition.

The offered product characteristics of competing alternatives may differ substantially in terms of (on-board) service, frequency level, legroom, and bags allowed on board. In medium- and long-haul flights, differences with respect to flight time and transfer time (when transferring at an intermediate hub) are also present. From this perspective, there is a great deal of product differentiation.

Most aviation markets are therefore best described as oligopolies with product differentiation (differentiated oligopolies). As airlines choose their quantities first (flight schedules) and adapt their prices to demand (yield management), we consider the Cournot model as the best choice. We will maintain this as the basis for this paper. The result of this model is that firm-specific cost changes will be passed through for less than half. If all competitors experience the same cost change, the pass-through may be greater than 50% depending on market conditions.

5. Exceptions to the rule

5.1. Slots and scarcity rents

In airports for which demand exceeds slot capacity, the right to use slots may create additional monopoly or oligopoly rents. At congested airports, prices are not determined by marginal costs of production. Rather, prices will generally be sustained at a level that clears demand at a given supply rate (Oxera, 2003). In these cases, the airline will set the price above the marginal costs, creating a rent. In turn, the airport may try to appropriate part of this rent for itself by increasing its airport charges. The extent to which this is possible depends on the market power the airport has vis-à-vis the airlines. Finally, taxes may transfer part of the rents of airlines and airports towards the government and may also affect the distribution of these rents (Button, 2005).

In these congested situations, the pass-through rate will usually be zero, as market prices are fully determined by capacity and

[4] In practice, some alliance partners may work more closely together than others. We assume, however, that alliance partners do coordinate capacity and fares, thereby reducing competition. The extent to which competition is reduced depends on the strength of the ties between partner airlines. However, it is difficult to take this into account in a modelling framework.

Table 3
Market concentration by concentration level.

HHI	Share of markets	Share of passengers	HHI (weighted average)	Competitors (weighted average)
≤1000	0%	0%	890	7.5
>1000 and ≤1800	1%	2%	1555	6.3
>1800	99%	98%	4689	3.1
Total	**100%**	**100%**	**4612**	**3.2**

Table 4
Market concentration by cabin class.

Cabin class	Share of passengers	HHI (weighted average)	Competitors (weighted average)
Business class	3%	6086	2.4
Economy class	97%	4622	3.2
Total	**100%**	**4612**	**3.2**

Table 5
Market concentration by number of competitors.

Relevant number of competitors	Share of passengers	Share of markets	HHI (weighted average)
1	10%	53%	9,643[a]
2	24%	24%	5831
3	28%	14%	4177
4	22%	6%	3223
5	11%	2%	2479
6	3%	1%	2084
7	1%	0%	1557
8	0%	0%	1351
9	0%	0%	1137
10	0%	0%	945
11	0%	0%	918
12	0%	0%	885
Total	**100%**	**100%**	**4612**

[a] The HHI of the monopolised markets is slightly below 10,000 because we assumed that airlines with a market share of less than 5% were not counted as competitors. They are, however, included in the calculation of the HHI. This means that for a market which is divided among two carriers on a 99:1 basis, only the dominant carrier with the 99% market share is included in the count of the relevant number of competitors, whereas the HHI is based on the market shares of both carriers (99% and 1%).

demand, not by costs. Higher costs will lead to lower rents, and vice versa (Forsyth and Gillen, 2007; Forsyth, 2008; Ernst & Young and York Aviation, 2007; Oxera, 2003).

A special situation occurs when cost increases cause airline profits to become zero or negative. In this case, the airline will have an incentive to increase prices. If this is not feasible, for instance, if the cost increase does not affect competitors, the airline may stop using the slot or negotiate lower airport charges. However, the possibility of cost reductions in the future or strategic considerations related to not allowing competitors to obtain a slot may induce the airline to continue using the slot, even if this results in losses in the short-term.

5.2. Compensating cost reductions

Confronted with cost increases, firms may try to reduce other costs. From an economic point of view, this reaction is not credible if these other costs are unrelated to the costs that have risen. In this case, these cost reductions were already profitable without the cost increase. If, for instance, fuel costs rise, this may induce an airline to save on labour costs to maintain profits. This labour cost reduction would then in all likelihood have been attractive without the fuel price increase. Not implementing profitable labour cost reductions would be irrational and would not be in the best interest of shareholders.[5]

However, reducing costs that have risen may be an appropriate response. Again taking increased fuel costs for airlines as an example, fuel efficiency is made more attractive from an economic point of view. Employing new flight procedures or different airplanes may also represent a rational method of reducing the impact of rising fuel costs on profitability.

5.3. Cross subsidisation

In price sensitive markets (high price elasticity), passing on cost increases leads to larger revenue losses than when an airline absorbs the increases. This means that in such markets, the pass-through is likely small. As price sensitivity differs between markets, there might be opportunity for airlines to cross-subsidise costs.

Cross subsidisation occurs when profits that an airline realises in markets where it has market power are used to support lower prices in markets which are subject to greater competition and are more elastic. The amount of market power airlines possess differs greatly depending in particular on the number of competitors in the market and the possibility of new competitors entering the market (contestability). Airlines may use profits from low-competition links (captive markets) to reduce their prices and increase their market share on high-competition links. In economic theory, this has been shown to be optimal for firms in several

[5] One exception may be that employees of a financially weak airline are more willing to make wage concessions when the airline is confronted with cost increases (Melo Filho et al., 2014). A second exception may be a situation in which shareholders are governments, aiming at goals other than profits, such as maintaining employment or winning elections. A third exception occurs when market power and profits lead to less managerial attention to controlling costs (Neven and Röller, 1996).

situations, especially among monopolies and oligopolies (see, e.g., Holmes, 1989). One might therefore expect that cost increases would lead to stronger price increases in low-competition markets than in high-competition markets. According to Wit et al. (2005) and Lowe et al. (2007), airlines are already cross-subsidizing up to a level that maximises profits.

5.4. Lumpiness of supply

Several studies have assumed that price increases are most likely passed through in markets with low price sensitivity. There are circumstances in which the pass-through of cost increases in such markets may still be unwise, as this might trigger capacity adjustments that result in large demand reductions.

When an airline operates at its break-even load factor, a small price increase may lower demand to below the break-even load factor. Often the airline is unable to adjust capacity by a small fraction due to the lumpiness of supply and is forced to reduce the flight frequency or cease the route altogether. Even a small increase in airport charges may therefore lead to a supply reduction. As a consequence, demand elasticity faced by airports may be high, especially in the short term.

Because of this, regional airports are very sensitive about increasing their airport charges. These airports are generally dependent on the traffic provided by a LCC. The supply of these low-cost airlines is, however, even more lumpy than that of traditional network carriers. Ryanair, for instance, operates only one type of aircraft in order to minimize maintenance costs and the costs of pilot training (type ratings) (Ryanair, 2014).

5.5. Airline business model

LCCs are more footloose than traditional carriers. As opposed to legacy carriers, LCCs often operate from multiple bases. This allows them to shift supply to other bases when costs at one of their bases increases, which may significantly affect traffic levels at individual airports.

5.6. Focus on market share

Economic theory usually suggests that airlines are profit maximisers. In practice, this is not always the case. Airlines may be in pursuit of market share, which means they strive to keep prices low and limit the pass-through of costs (Forsyth, 2008; Vivid Economics, 2007).

5.7. Unlevel playing field

An unlevel playing field may also be the cause of a reduced pass-through of costs. ETS, for instance, currently applies only to intra-European flights. This has resulted in an unlevel playing field in intercontinental markets providing service to and from Europe. Airlines that serve these markets directly do not have to surrender ETS allowances, whereas other carriers that serve these markets with an intermediate stop at a European hub will need to surrender allowances for the intra-European flight leg.

An example is the market between Frankfurt and New York. Lufthansa operates this route directly. Because this is an intercontinental flight, it is not subject to ETS, and no allowances must be surrendered. However, when the market is operated indirectly by British Airways via its London hub, the airline must surrender ETS allowances for the flight leg from Frankfurt to London. In this market, British Airways might therefore not (completely) pass through the ETS costs, because this would harm its competitive position.

5.8. Pass-through lags

When cost changes are passed through, this is often done so with a delay. There are various reasons why the pass-through of cost changes does not happen immediately (Menon, 1994):

- *Low marginal costs*. Given the amount of supply, low marginal costs of additional passengers may imply low pass-through rates. If, e.g., fuel costs increase, almost no additional costs would be incurred by the marginal passenger. Airlines place a lot of effort on advanced pricing techniques such as advanced booking and yield management, to optimise aircraft capacity. We may assume that airlines maximise revenues by adapting prices to optimise the load factor both before and after a cost increase. Given that the marginal costs of additional passengers will hardly change, the optimal load factor and, by extension, the optimal price will not change much. In the long run, however, higher costs may lead to changes in supply (see paragraph below).
- *Costs of changing supply*. Passing through cost changes leads to a demand reaction. To meet the new demand, suppliers must adjust their output levels. Because supply changes may come at a cost, suppliers may avoid passing on cost changes. Suppliers would be willing to incur such costs only if the cost change is expected to last long enough to at least recoup such costs. Even if the cost change is viewed as relatively permanent, there would be little point in changing prices immediately. What is more likely is that prices gradually fall while supply is adapted. Eventually, pass-through should be complete (Krugman, 1987);
- *Switching costs*. Customers might be reluctant to give up satisfactory relationships with traditional suppliers and commitments, which explains why buyers do not immediately respond to price differences. There are a variety of costs associated with switching suppliers: information acquisition, evaluation of product quality and reliability of supply, and establishment of new contractual links.[6]

Forsyth (2008) makes a distinction between the short-term and long-term effects of cost increases. In the short term, airline profitability will be reduced regardless of the market structure. In the long run, unprofitable routes will be dropped. In oligopolistic and competitive markets, some firms may exit the market. This will restore the profitability of remaining airlines.

5.9. Asymmetric price response

As noted by Peltzman (2000), there is a perception by consumers that there are asymmetries in the way costs are passed through in many markets. Bacon (1991) termed this the ‘rocket and feather’ response, whereby prices increase quickly when costs go up but fall slowly when costs decrease. Various explanations for asymmetric responses to prices are provided in the extant literature. We identify below those that are relevant to the aviation industry:

- Focus on market share and/or oligopolistic coordination, as described above.

[6] Menon (1994) also mentions menu costs as a reason why cost changes are not passed through instantly. Changing prices may come at a cost in some industries, so-called menu costs. Given the costs associated with changing prices, firms may ignore cost changes perceived as transitory and respond only to movements which are believed to be of a more permanent nature. In the aviation industry, where prices change continuously, menu costs are most likely negligible.

- *Search costs*. A price increase raises the incentive to search for a lower-priced alternative, while a decrease in price lowers the incentive to search. Sellers may be reluctant to raise prices quickly after a cost increase, as a consumer search is stimulated by lower-priced alternatives that do not increase prices immediately. When prices begin to decline, consumers search less, so there is no change in the demand for higher-priced alternatives, and prices adjust more slowly. The fact that this model predicts an increased search when prices rise and a decreased search when prices decline explains the asymmetry (Radchenko, 2005).
- *Consumer response*. When the price of inputs rise, this may lead to a quick response by consumers, as they expect even higher prices the next day. This behaviour will accelerate price increases. If input prices are falling, consumers may expect the decrease to continue over the next days, and they prefer to wait until prices reach their expected lower levels (Brown and Yucel, 2000). This means that an increase in input prices leads to a quicker demand reaction (and therefore price adjustments) than decreases in input prices.
- *Perishable goods*. Sellers of perishable goods may resist the temptation to increase prices for fear of being left with spoiled products (Ward, 1982). Airline seats can also be seen as perishable goods. When a seat is not sold before departure, it loses all value. Due to the fear of being stuck with a large number of unsold seats, airlines may choose not to pass through cost increases immediately, as opposed to cost decreases.

Wadud (2015) found empirical evidence for the existence of this ‘rocket and feather’ response. The author demonstrates that higher jet fuel prices are rapidly reflected in higher air fares, whereas lower fuel prices yield a slower adjustment in air fares. Additional research is available in other industries, but the results are mixed. Al-Gudhea et al. (2006), Asplund et al. (2000), Bacon (1991), Borenstein et al. (1997), Borenstein and Shepard (1996), Chen et al. (2005), Duffy-Deno (1996), Dunis et al. (2005), Galeotti et al. (2003), Grasso and Manera (2006), Karrenbrock (1991), Lanza (1991), Manning (1991), Reilly and Witt (1998), and Ye et al. (2005), for instance, found evidence of asymmetric price reactions in the gasoline market. Other studies, such as those conducted by Bachmeier and Griffin (2003), Balke et al. (1998), Godby et al. (2000), Meyler (2009), Norman and Shin (1991) and Shin (1994), found no evidence of asymmetry.

6. Conclusions

According to economic theory, the pass-through of airline cost changes strongly depends on the type of cost change (firm-specific or sector-wide) and market conditions. In monopolistic markets, most or all of a cost change may be passed through, depending on the shape of the relationship between prices and demand. In more competitive situations, sector-wide cost changes may also be passed through to a large extent, although not necessarily fully. In these competitive situations, cost changes that affect only one competitor will only be passed through to a small extent.

In aviation, a pass-through rate of 100% is often assumed based on the reasoning that the aviation sector is highly competitive. Empirical evidence with respect to the pass-through of cost changes within the aviation industry is limited. We analysed market concentration in all airline markets in the world, and generally found a high level of concentration. Additionally, different airlines offer a variety of products in terms of, e.g., service, flight frequency, legroom, bags allowed on board, flight time and transfer time. Therefore, most aviation markets can be characterised as differentiated oligopolies. As airlines choose their quantities first (flight schedules) and adapt their prices to demand (yield management), we consider the Cournot model as the best choice. In such markets, firm-specific cost changes will be passed through for less than 50%, and sector-wide cost changes will be passed through by more, depending on market conditions.

In specific situations, the pass-through rate may be different. If the capacity of the airport is limited, pass-through will likely be zero. In this case, cost changes are generally absorbed by changes in scarcity rents. Airlines that operate in both competitive and non-competitive markets may use the non-competitive markets as a ‘cushion’ to partly absorb cost increases. Another method of partly absorbing shocks may be to strive for cost reductions, especially with respect to inputs for which costs have risen.

It is often thought that cost increases are passed through more quickly than cost decreases. Under oligopolistic competition, cost increases are passed through rather quickly; otherwise, margins become negative. Decreases in costs will only be passed through after one competitor undercuts the coordinated price. In addition, consumer reactions may differ between price increases and price reductions.

The lack of empirical research with respect to the pass-through of airline cost changes, may be explained by the difficulty in obtaining and analysing detailed ticket fare data. Daily data should allow researchers to better determine to what extent cost changes are passed through in the ticket price. Such data may be harvested from the Internet. Such an analysis would require controlling for many factors, such as competition, airport capacity, hedging of fuel costs, and product changes (e.g., taking checked-in baggage and meals out of the base fare). Such research would not be easy, but it appears worthwhile.

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Appendix A. Multi-airport systems

Table A.1
Multi-airport systems.

Continent	Country	Multi-airport region	Airport 1		Airport 2		Airport 3		Airport 4	Airport 5
Asia/Pacific	Australia	Melbourne	AVV	Avalon	MEL	Melbourne				
Asia/Pacific	China	Hong Kong	HKG	Hong Kong	SZX	Shenzhen				
Asia/Pacific	China	Shanghai	PVG	Shanghai (Pu Dong)	SHA	Shanghai (Hongqiao)				
Asia/Pacific	Japan	Osaka	KIX	Osaka (Kansai)	UKB	Osaka (Kobe)	ITM	Osaka (Itami)		
Asia/Pacific	Japan	Tokyo	HND	Tokyo (Haneda)	NRT	Tokyo (Narita)				

Table A.1 (*continued*)

Continent	Country	Multi-airport region	Airport 1	Airport 2	Airport 3	Airport 4	Airport 5
Asia/Pacific	Taiwan	Taipei	TPE Taipei (Taoyuan)	TSA Taipei (Sung Shan)			
Asia/Pacific	Thailand	Bangkok	BKK Bangkok (Intl)	DMK Bangkok (Don Muang)			
Asia/Pacific	South Korea	Seoul	ICN Seoul (Incheon)	GMP Seoul (Gimpo)			
Europe	Belgium	Brussels	BRU Brussels (Zaventem)	CRL Brussels (Charleroi)			
Europe	Denmark	Copenhagen	CPH Copenhagen	MMX Malmo			
Europe	Germany	Berlin	TXL Berlin (Tegel)	THF Berlin (Tempelhof)	SXF Berlin (Schoenefeld)		
Europe	Germany	Dusseldorf	DUS Dusseldorf (Intl)	DTM Dortmund	CGN Cologne/Bonn	NRN Niederrhein	
Europe	Germany	Frankfurt	FRA Frankfurt (Fraport)	HHN Frankfurt (Hahn)			
Europe	Germany	Hamburg	HAM Hamburg (Fuhlsbuettel)	LBC Hamburg (Luebeck)			
Europe	France	Paris	ORY Paris (Orly)	CDG Paris (Charles De Gaulle)	BVA Paris (Beauvais-Tille)		
Europe	Italy	Bologna	BLQ Bologna	FRL Forli			
Europe	Italy	Milan	MXP Milan (Malpensa)	LIN Milan (Linate)	BGY Bergamo		
Europe	Italy	Pisa	PSA Pisa	FLR Florence			
Europe	Italy	Rome	FCO Rome (Fiumicino)	CIA Rome (Ciampino)			
Europe	Italy	Venice	VCE Venice	TSF Treviso			
Europe	Netherlands	Amsterdam	AMS Amsterdam	RTM Rotterdam	EIN Eindhoven		
Europe	Norway	Oslo	OSL Oslo	TRF Oslo (Torp)	RYG Moss		
Europe	Austria	Vienna	VIE Vienna	BTS Bratislava (Slovakia)			
Europe	Russia	Moscow	DME Moscow (Domodedovo)	SVO Moscow (Sheremetyevo)	VKO Moscow (Vnukovo)		
Europe	Spain	Barcelona	BCN Barcelona	GRO Gerona	REU Reus		
Europe	Turkey	Istanbul	IST Istanbul (Ataturk)	SAW Istanbul (Sabiha Gokcen)			
Europe	United Kingdom	Belfast	BHD Belfast (City)	BFS Belfast (Intl)			
Europe	United Kingdom	Glasgow	GLA Glasgow (Intl)	EDI Edinburgh	PIK Glasgow (Prestwick)		
Europe	United Kingdom	London	LHR London (Heathrow)	LGW London (Gatwick)	STN London (Stansted)	LTN London (Luton)	LCY London (City)
Europe	United Kingdom	Manchester	MAN Manchester	LPL Liverpool	LBA Leeds/Bradford	BLK Blackpool	
Europe	Sweden	Gothenburg	GOT Gothenburg (Landvetter)	GSE Gothenburg (Saeve)			
Europe	Sweden	Stockholm	ARN Stockholm (Arlanda)	BMA Stockholm (Bromma)	NYO Stockholm (Skavsta)	VST Stockholm (Vasteras)	
Latin America	Argentina	Buenos Aires	AEP Buenos Aires (Newbery)	EZE Buenos Aires (Pistarini)			
Latin America	Brasil	Belo Horizonte	PLU Belo Horizonte	CNF Tancredo			
Latin America	Brasil	Rio de Janeiro	SDU Rio De Janeiro (Dumont)	GIG Rio De Janeiro (Intl)			
Latin America	Brasil	Sao Paulo	CGH Sao Paulo (Congonhas)	GRU Sao Paulo (Intl)			
Latin America	Mexico	Mexico	MEX Mexico City (Juarez Intl)	TLC Mexico City (Toluca)			
Middle East	Iran	Teheran	THR Tehran (Mehrabad Intl)	IKA Tehran (Imam Khomeini Intl)			
Middle East	Israel	Ten Aviv	TLV Tel Aviv (Ben Gurion)	SDV Tel Aviv (Yafo Sde Dov)			
Middle East	UAE	Dubai	DXB Dubai	SHJ Sharjah			
North America	Canada	Toronto	YYZ Toronto (Pearson Intl)	YHM Hamilton	YTZ Toronto (City Centre)		
North America	Canada	Vancouver	YVR Vancouver	YXX Abbotsford			
North America	United States	Boston	BOS Boston	PVD Providence	MHT Manchester		
North America	United States	Chicago	ORD Chicago (O'Hare)	MDW Chicago (Midway)			
North America	United States	Cleveland	CLE Cleveland	CAK Akron/Canton			
North America	United States	Dallas	DFW Dallas/Ft. Worth (Intl)	DAL Dallas/Ft. Worth (Love Fld)			
North America	United States	Detroit	DTW Detroit	FNT Flint			
North America	United States	Houston	IAH Houston (G.Bush Intl)	HOU Houston (Hobby)			
North America	United States	Los Angeles	LAX Los Angeles	SNA Santa Ana	ONT Ontario	BUR Burbank	LGB Long Beach
North America	United States	Miami	MIA Miami (Intl) FL USA	FLL Ft. Lauderdale (Intl) FL USA			

(*continued on next page*)

Table A.1 (*continued*)

Continent	Country	Multi-airport region	Airport 1		Airport 2		Airport 3		Airport 4		Airport 5
North America	United States	New York	LGA	New York (Laguardia)	JFK	New York (Kennedy)	EWR	Newark/New York	ISP	Long Island MacArthur	
North America	United States	Norfolk	ORF	Norfolk	PHF	Newport News					
North America	United States	Orlando	MCO	Orlando (Intl)	SFB	Orlando (Sanford)					
North America	United States	Philadelphia	PHL	Philadelphia	ACY	Atlantic City					
North America	United States	San Diego	SAN	San Diego	TIJ	Tijuana (Mexico)					
North America	United States	San Francisco	SFO	San Francisco	OAK	Oakland	SJC	San Jose			
North America	United States	Tampa	TPA	Tampa	SRQ	Sarasota/Bradenton	PIE	St. Petersburg			
North America	United States	Washington	DCA	Washington (Reagan)	IAD	Washington (Dulles)	BWI	Baltimore			

Source: Bonnefoy and Hansman (2008).

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