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Pass-through of Airline Cost Changes – What Does Economic Research Say?

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Abstract

Airlines costs change on a day to day basis. An important question for airlines and regulators is whether airlines are able to pass-through cost changes into their prices. In this paper we investigate which pass-through rates are most appropriate based on economic theory and empirical literature. According to economic theory the pass-through of costs depends strongly on the type of cost increase (one firm or sector wide) and market conditions (monopoly, oligopoly, perfect competition). A pass-through rate of 100 percent is often assumed based on the reasoning that the aviation sector is highly competitive. We argue however that most aviation markets can be better characterised as oligopolies or monopolistic competition. In such markets one-firm cost changes will be passed-through for less than half and sector-wide cost changes are passed through by more than 50 percent, depending on the market conditions. Other factors that influence the pass-through rate are available airport capacity (congestion), scope for cross-subsidization, the fairness of competition and the price sensitivity of demand. Little empirical evidence on the pass-through of costs exists. This probably has to do with the difficulty to obtain reliable fare data and with the difficulty to isolate the price effects of a certain cost change.

1. Introduction

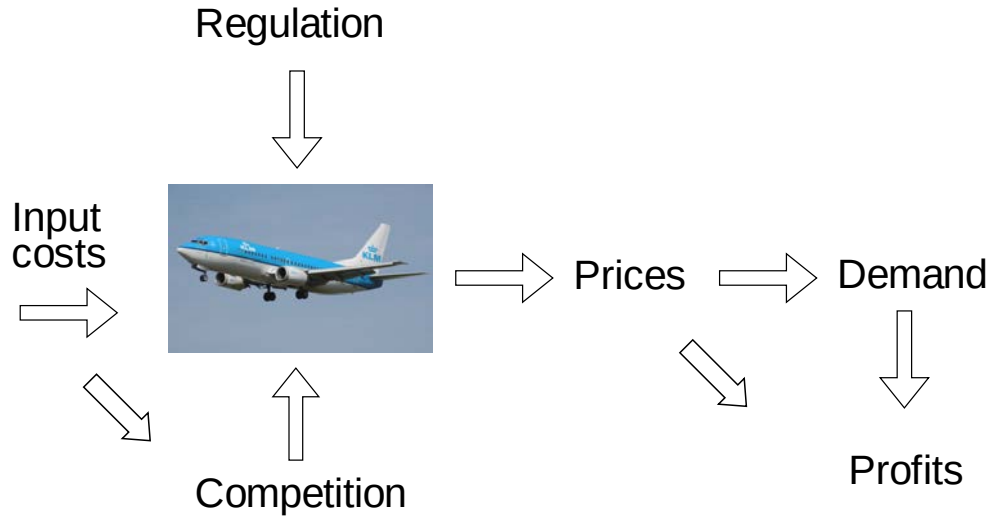
The costs of airlines change over time. There is a general trend towards low costs, driven by fierce competition from Low Cost Carriers on many connections. Fuel prices fluctuate, in large part due to changes in crude oil prices. Labour costs may go up fast or slow. And finally, government regulation often changes, affecting costs.

An important question for airlines and regulators is whether airlines are able to pass through cost changes into their prices. If e.g. a cost increase for a particular airline will be transferred fully towards higher fares (100 percent pass-through), the costs will be borne primarily by its passengers. In reaction to the higher price, airlines may suffer from lower sales. Also, if the airlines' competitors do not raise their prices, the airlines' market share, sales and profits may fall. If, on the other hand, the cost increase is not passed on, the volume of demand stays the same but in this case there is a strong impact on profits.

Figure 1 summarises these changes. Regulation and input price volatility change the costs of airlines. These cost changes may be passed through to higher prices depending on competition, but this will influence demand and profits. Particularly relevant is whether

regulation costs and changes in input costs only affect the costs for one airline, or for all competitors.

Figure 1 Pass-through of cost changes



The purpose of this paper is to show what economic research tells us about this pass-through of cost changes. Under which conditions will cost changes be passed through completely? And in which circumstances will cost changes be absorbed partly or fully by the airline itself? In economic theory, this depends on the type of market in which a firm operates. Each market type leads to a different pass-through of costs.

This paper will start by describing different market types and the likely pass-through in each type. Next, we sketch the characteristics of the markets which airlines operate in, and try to draw conclusions on the amount of pass-through which may be expected. Then we describe economic research on price reactions which occur in practice. Finally, we draw conclusions.

2. Pass-through in economic theory

2.1 Pass-through in different market types

In markets characterized by *perfect competition*[1], sector-wide cost increases will be passed on completely (see Table 1). In these markets, fierce completion 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 alternative is to go out of business. If, however, costs go up for only one firm, this firm will actually have to leave the market, because its competitors will not change their prices.

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

For *monopoly* markets[2], the amount of pass-through depends on the shape of the demand curve: the relation between the price and the quantity sold (see again Table 1). If this is a linear curve, 50% of cost changes will be passed through; the other half will be absorbed in a reduction of the quantity supplied[3]. For non-linear demand curves, the pass-through may be either 100%, 0-100% or even larger than 100% (see table 1). For some shapes of demand curves, the amount of pass-through depends on the price elasticity: a higher elasticity leads to a smaller pass-through. An example of a monopoly market is the high-voltage electricity network: it is not efficient to have two networks in the same place. To limit market power, monopolies are often regulated by governments, for instance by imposing price caps.

The results for monopoly markets also apply to *monopolistic competition* markets. In these markets products are not homogenous, making each competitor to some extent a monopolist. However, as the competitors provide close substitutes, price elasticities may be high. In such situations price increases by individual firms may cause a large loss of sales. This may limit the scope for pass-through, depending on the shape of demand curves. An example of a monopolistic competition market is the market for beer. Beer comes in different tastes from many suppliers. Mass-produced beers like Heineken and Carlsberg may be hard to distinguish, but premium beers such as Westvleteren have a unique taste and/or reputation, which induces the producers to limit supply and customers to pay high prices.

Table 1 Pass-through in different market types

Type of competition	**Other assumptions**	**Pass-through**	**Source**
Perfect competition	One-firm cost change	0%	Bulow and Pfleiderer (1983)
	Sector-wide cost change	100%	Zimmerman and Carlson (2010)
Oligopoly (Cournot type)	Homogenous product Linear demand Equal-size firms		Ten Kate and Niels (2005)
	One-firm 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)
	One-firm cost change	20-50%	
	Sector-wide cost change	Larger than 20-50%	
Oligopoly (Bertrand type)	Differentiated product		Zimmerman and Carlson (2010)
	One-firm cost change	0-50%	
	Sector-wide cost change	Larger than 50%[4]	

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

[3] It may seem surprising that - for linear demand curves - the pass-through rate does not depend on the price elasticity. Ten Kate and Niels (2005) confirm that for inelastic demand, the extension of the consumer base resulting from a price decrease is small, making it unattractive to pass on cost savings. However they add that with inelastic demand, the price-cost difference is also high, so that even a small extension of the consumer base boosts profits considerably. These two countervailing effects cancel each other out.

[4] 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.

Monopoly, monopolistic competition	Linear demand	50%	Varian (1992)
	Constant elasticity demand curve, $-\infty <$ price elasticity < -1	>100%	
	Power demand curve	0-100%	Bulow and Pfleiderer (1983)
	Log demand curve	100%	

In *oligopoly* markets[5] we see partial pass-through in Table 1. A relatively large part of costs is passed through if the cost increase is sector-wide. Firm-specific cost changes are passed through to a smaller extent, especially if there are many competitors. In this case, cost increases lead to lower profits. We note that the number of active competitors in a market may not give a full picture of competition. If new competitors can easily enter the market, this will keep prices closer to costs, increasing the rate of pass-through of cost changes.Gas stations provide an example of an oligopoly market. A limited number of companies like Shell, Esso (Exxon) and Q8 provide virtually identical products[6]. In oligopolies, collusion may take place, in which the suppliers act as monopolist together and make deals on co-ordinated prices (such cartels are forbidden in many countries). Co-ordination may also be more implicit, with one firm (with a large market share) acting as a price leader followed by others.

From this brief sketch we may conclude that the amount of pass-through depends strongly on the type of cost increase and on market conditions. Market-wide cost increases will be passed through to a large extent, but not necessarily 100 percent. One-firm cost increases will be passed on to a relatively small extent. Several monopoly (or monopolistic competition) situations show a pass-through of 100 percent, in one case even more.

2.2 Aviation markets

Aviation markets do not fit easily in the rather stylized market types described above. At the supply side, most aviation markets look like oligopolies, with a relatively small number of airlines/alliances. Looking from the demand perspective, the relevant unit is not a link between two airports but a trip from A to B. This trip can often be made using several airlines with different characteristics. Especially in the long haul there are generally many competing alternatives available for the passenger to choose from. Moreover, this often implies different routes (e.g. using another hub as a transfer point), frequencies, waiting times, on-board service and other characteristics. From this point of view, there is a lot of product differentiation. This is a characteristic of monopolistic competition. Therefore, one may describe most aviation markets as either oligopolies with product differentiation (differentiated oligopolies), or as monopolistic competition markets with a small number of competitors.

Looking at the different types of oligopoly and monopolistic competition markets in Table 1, aviation markets seem to be best described by the differentiated oligopolies studied by

[5] The assumption of oligopoly markets is that there is a limited number of suppliers.

[6] Some companies devote marketing campaigns to the special quality of their product, e.g. pointing at special fuel additives. In practice, consumers are hardly willing to pay more for these alleged benefits.

Zimmerman and Carlsson (2010). The result of these models is that one-firm cost changes will be passed through for less than half. If all competitors experience the same cost change, the pass-through may be larger than 50%, depending on market conditions.

2.3 Cross subsidisation

Cross subsidisation occurs when profits that an airline makes in markets where it has market power are used to support lower prices in markets that are subject to greater competition and are more elastic. The amount of market power of airlines differs strongly, depending in particular on the number of competitors on the link involved and the possibilities for new competitors to enter the market (contestability). Airlines may use profits from low-competition links (captive markets) to reduce their prices and increase their market shares on high-competition links. In economic theory, this has been shown to be optimal for firms in several situations, in particular monopolies and oligopolies (see e.g. Holmes, 1989). One might expect that cost increases would lead to stronger price increases in low-competition markets than in high-competition markets.

2.4 Slots and 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. Prices will be at a level which clears demand at a given supply (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 to itself by charging a higher fee for the use of the slot, if the airport has market power vis-à-vis the airline. Finally, taxes may transfer part of the rents of airlines and airports towards the government, but may also impact on the distribution of these rents (Button, 2005).

In these congested situations, the pass-through rate will usually be zero[7], as market prices are fully determined by slot capacity and demand, not by costs. Higher costs will lead to lower rents, and vice versa. The distribution of the rent change between airline and airport will depend on their market power. A special situation occurs if cost increases cause rents 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 consider to stop using the slot. However, the possibility of costs reductions in the future, or strategic considerations of not allowing competitors to obtain the slot, may induce the airline to continue using the slot, even if this incurs losses.

2.5 Compensating cost reductions

Confronted with cost increases, firms may try to reduce other costs. However, if these other costs are unrelated to the costs which have risen, one may ask why these cost reductions were

[7] However, airlines may still be able to pass on some of the costs of a carbon tax, if flights from the congested slot compete with flights from uncongested slots (Forsyth, 2008, p. 23-24).

not implemented before (or without) the cost increase. If for instance fuel costs go up, this may induce an airline to save on labour costs to maintain profits. This labour cost reduction would than in all likelihood have been profitable without the fuel price increase. Not implementing profitable labour cost reductions would be irrational and not in the interest of shareholders[8].

On the other hand, reducing the costs which have risen may be an appropriate response. Taking again increasing fuel costs for airlines as an example, reducing the amount of fuel consumed by implementing other flight procedures or by using other airplanes may be a way to reduce the impact on total costs.

2.6 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):

- Menu costs. Sticky prices in the short-run can be explained in terms of the costs associated with frequently changing prices. Each price decision involves the collection and processing of new information. To avoid these costs a firm could choose to set its price and maintain this price by absorbing cost changes into profit margins. 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. Nakamura and Zerom (2010) show that menu costs have a negligible effect on long-run pass-through but that they play an important role in explaining short-run pricing dynamics. We note that menu costs may be low in aviation, as prices are changed continually, apparently without large costs involved;
- Costs of changing supply. Passing through cost changes leads to a demand reaction. To meet the new demand, suppliers need to change their output levels. As 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 being relatively permanent, there would be little point in changing prices immediately if there is no capacity to meet the expanded demand. What is more likely is that prices gradually fall while supply is expanded. Eventually, pass-through should be complete (Krugman, 1987);
- Lumpiness of supply. Airline fleets generally consist of a limited number of aircraft types. Some airlines, especially low cost carriers such as Ryanair, operate only one type to save costs. This means that supply is lumpy. Even when an airline operates multiple aircraft types, it is generally not easy to make shifts on short notice. Again

[8] One exception may be that the cost increases open up a window of opportunity to renegotiate labour contracts with unions or employees. A second exception may be a situation in which the shareholders are governments, aiming at other goals than profits, such as maintaining employment or winning elections. A second exception occurs when market power and profits lead to less managerial attention for controlling costs (Neven and Röler, 2008).

there would be little point in adjusting prices if there are no aircraft available within the fleet to meet the new demand;

- Switching costs. Customers might be reluctant to give up satisfactory relationships with traditional suppliers and commitments, explaining 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 establishing new contractual links.

Forsyth (2008) makes a distinction between 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 from the market. This will restore the profitability of airlines. The cost increases occasioned by the policy will ultimately be passed on to passengers.

2.7 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. In the models presented so far, cost increases and cost reductions have symmetric effects. Other theories predict that in oligopolies, reactions may differ. In the literature various explanations for the asymmetric response of prices are given. We mention the ones that are relevant to the aviation industry:

- Focus on market share. In the so-called kinked demand model, firms focus on their market share (Sweezey, 1939). In this case a price reduction by one firm is immediately followed by its competitors, in order to retain their market shares. On the other hand, a price increase by one firm is not followed, allowing the competitors to increase their market share. A focus on the firm's market share may be interpreted as aiming at long-term 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 (Bashkar, 1988);
- Oligopolistic coordination. In competitive markets a cost increase would trigger an immediate price adjustment because, otherwise, margins may become negative. There is no such restraint when prices decline. Reduction occurs only if there is a significant drop in sales caused by price cutting by other retailers. 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, there should be a faster adjustment of prices to a cost reduction when oligopolistic coordination fails (Borenstein et al., 1997);
- Search costs. A price increase raises incentives to search for a lower priced alternative, while a decrease in the price lowers the incentive to search. Sellers may be reluctant to raise prices fast after a cost increase, but an increase in consumer search leads to jumps in demand for lower-priced alternatives that do not increase prices immediately. To meet the increased demand, sellers are forced to increase prices leading to a fast response of prices. When prices start declining, consumers search less so that there is

no change in the demand for higher-priced alternatives and prices adjust slower. The fact that this model predicts an increased search when price rises and decreased search when price declines 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 the price increase. If input prices are falling, consumers may expect the decrease to continue in 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).

3. Price reactions in practice

There is an extensive literature in a number of fields on the pass-through of costs. Most empirical evidence is available on the pass-through of fuel costs (gasoline, diesel and other consumer fuels), emission costs, exchange rates and interest rates. Literature on the pass-through of cost changes in the aviation sector mainly focuses on fuel costs and emissions costs (in particular the EU's Emissions Trading System ETS). Empirical evidence is however limited. This section discusses the available literature for the aviation sector.[9]

3.1 Fuel costs

The pass-through of fuel costs in the airline industry has been discussed in only a few studies in the literature. Özmen (2009) regressed ticket prices for domestic US routes against fuel prices and found that a 1 percent increase in fuel prices resulted in a 4 percent increase in fares on average. As fares are higher than fuel costs, this would amount to a pass-through rate of more than 400 percent (e.g., if fuel costs are one third of fares, the pass-through rate would be 1,200 percent). From a theoretical point of view, pass-through rates of up to 100 percent would be expected. As Table 1 shows, rates above 100 percent are possible in specific cases, but (much) more than 400 percent seems rather extreme. However, Özmen (2009) does not offer an explanation for this rate of pass-through. No conclusive evidence is found for asymmetric pass-through. Also, Özmen (2009) notes that there are questions about the quality of the data used. Therefore, the validity of this result may be questioned.

PWC (2005) regressed UK air travel prices against kerosene prices and found that airlines (including low cost carriers) pass on 90 to 105 percent of the increases in costs of kerosene with some delay. Duplantis (2010) and Toru (2011) also found pass-through rates close to one, 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 differ statistically from zero. This is supported by Borenstein and Rose (2007) who note that airlines face

[9] Although empirical evidence is limited for the aviation sector, much empirical material is available for other sectors. Appendix A contains an overview of the studies performed for other sectors.

difficulties in passing on fuel cost increases as they are generally unable to make rapid changes to capacity due to logistical reasons. They did not find empirical evidence that kerosene price shocks led to capacity changes.

3.2 Emission costs

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. No empirical evidence on the passing through of ETS costs is available for the aviation industry. One might expect the pass-through of CO_2 emission (ETS) costs to be similar to the costs of kerosine, as CO_2 emissions are proportional to fuel use (Kolkman et al., 2012).

Many studies (Anger en Kohler, 2010; Boon et al., 2007; European Commission, 2006; Frontier Economics, 2006; Lowe et al., 2007; Mayor en Tol, 2010; Mendes en Santos, 2008; Morrell, 2007; PWC, 2005; Scheelhaase et al., 2010; Scheelhaase en Grimme, 2007; Vivid Economics, 2007; Wit et al., 2005) assume that the 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. In section 2.1 we showed that under perfect competition sector-wide cost increases will be fully passed-through. In case only one firm is faced by the cost increase, this firm cannot raise its prices and most likely will leave the market. ETS is not a sector-wide scheme. In some markets carriers are able to evade ETS costs in part or in full (also see section 3.2.5).

Other studies assume lower pass-through rates for ETS costs, based on one or more of the following arguments:

- Monopolistic or oligopolistic competition;
- Fixed capacity in the short run;
- Capacity restrictions;
- Focus on market share;
- Price sensitivity of the passenger / airline business model;
- Unlevel playing field.

Each of these arguments shall be described in more detail below:

3.2.1 Monopolistic or oligopolistic competition and fixed capacity in the short run

Forsyth and Gillen (2007) point out that only in highly competitive markets, ETS costs are likely to be fully passed through to passengers. But as most air markets are monopolies or oligopolies, the actual pass through is likely considerably smaller, at least in the short run. In the short term it will be more difficult for airlines to pass on costs. 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 in the short run is incomplete, but it may increase over time. According to Bloomberg (2011) airlines will on average pass on 30 percent of ETS costs in the short-term and 60 percent in the long-term.

Ernst & Young and York Aviation (2007) reach similar conclusions. They state that full pass-through is only conceivable in a situation of perfect competition[10]. The study assumes however that due to oligopolistic competition and the existence of congested airports, airlines are unable to fully pass through increases in costs. For airports without congestion a pass-through rate of 50-100 percent was assumed and for congested airports no pass-through was assumed (see below). This resulted in a weighted average rate of 29-35 percent, where the lower value applies to Low Cost Carriers and the higher for network carriers.

In section 2.2 we also argued that most aviation markets are best described by oligopolistic or monopolistic competition, resulting in pass-through rates (well) below 100 percent.

Bloomberg (2011) and PWC (2005) criticise the assumption of monopolistic or oligopolistic competition as this would mean that price setting is above marginal costs. This would mean that airlines are making excessive profits whereas profit margins in the aviation industry appear very low.[11] There are various explanations however for profit margins to be low, even under monopolistic or oligopolistic competition:

- Rents are used by legacy airlines to cover high employment costs. A lot of airlines indeed don't make much money, but some do, especially the newer ones that are not affected by generous financial schemes for their employees. Ryanair's net margin for instance has been around 12 percent for the last two years (Ryanair, 2013). The net margin for easyJet was slightly lower, averaging 8 percent over the last two years (easyJet, 2013). Legacy airlines on the other hand grew up in an age where they were protected by aviation bilaterals and much of the rents went to the employees in terms of high salaries or royal pension schemes.
- Overcapacity during economic downturns. The airline industry historically over-orders aircraft when demand shows strong growth and load factors peak, e.g. at the peak of the economic cycle. As the new aircraft are delivered with a lag of about two years, much of the capacity arrives in the following low in the economic cycle. This means that there is overcapacity during the downturns, leading to relatively high costs and low revenues, leaving little or no profit at all. Airlines such as Ryanair overcome this by ordering aircraft at the bottom of the economic cycle when prices are low (Christie, 2012), making sure that new capacity arrives when the economy starts to pick up.
- Fear of market entry by competitors. In competitive markets, market entry by a new airline generally results in overcapacity and reduced load factors for the incumbents. In contestable markets, which competitors can easily enter, the incumbents may choose not to incur the full rent, but instead to pass (part of) the rent through to the consumer to make it less attractive for competitors to enter the market. This means that at least part of the rent will not be captured by the airlines, resulting in lower profits.

[10] However, in section 2 we showed that a 100% pass-through is also possible in monopoly or monopolistic competition markets.

[11] Ernst & Young and York Aviation (2007) estimated that airline operating margins for network carriers reduced from 4 to 2.4 percent with a pass-through of 25 percent of ETS costs. The margins for low cost carriers reduced from 15 to 11.1 percent when passing on 30 percent of the ETS costs.

3.2.2 Capacity restrictions

Forsyth and Gillen (2007), Forsyth (2008) and Ernst & Young and York Aviation (2007) and Oxera (2003) showed that in cases of constrained airport capacity, no pass through at all is likely to occur, as any additional costs would be borne by airlines in the form of reduced slot rents.

Wit et al. (2005) claim that although a 100 percent pass-through is unlikely at congested airports, empirical data show that cost increases are in fact passed through in full at congested airports. This might be because airlines are not able to capture the scarcity rents in practice, as the landing and take-off slots are not owned by the airlines but by the airport. Airlines probably pay more for landing and take-off slots at congested airports. This might also be the reason why carriers operating at congested airports, such as London Heathrow, make little or no profit. Carriers also dispute the existence of scarcity rents (Competition Commission, 2002).

When capacity is artificially restricted, for instance in markets where capacity is regulated by governments, the arguments raised above do not hold and airlines might be able to incur scarcity rents. In such cases no pass through at all is likely to occur, as any additional costs would be borne by airlines in the form of reduced slot rents (Forsyth and Gillen, 2007; Forsyth, 2008).

3.2.3 Focus on market share

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

3.2.4 Price sensitivity of the passenger / airline business model

Several studies found that ETS costs are most likely 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). Some argue however that the business segment has been exploited to the full and the segment is becoming more and more price elastic. Airlines are also keen to preserve their share of premium passengers, because of their high contribution to profitability (Morrell, 2009). Due to the lower fares of 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 network carriers are able to pass-through the complete cost increase, but LCCs are not able to do so.

Several studies have assumed that price increases are most likely passed through in markets with low price sensitivity. There are however circumstances in which the pass-through of cost increases in such markets may still be unwise as it might trigger capacity adjustments which result in large demand reductions. When an airline operates at its break-even load factor, a

small cost 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, thedemand 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 low cost carrier. The supply of these low cost airlines is however even more lumpy than that of the traditional network carriers. Ryanair for instance operates only one type of aircraft to reduce costs (Ryanair, 2014). In addition, low cost carriers are more footloose than the traditional carriers. Opposed to the traditional carrier, low cost carriers often operate from multiple bases, which allows them to shift supply to other bases when visit costs at one of their bases increases. Capacity reductions may therefore have a relatively large impact on the airport's business. In price sensitive markets (high price elasticity), passing on cost increases leads to larger revenue losses than when the airline would absorb the increases. This means that in such markets the pass-through is likely small. As the price sensitivity differs between markets, there might be scope for airlines to cross-subsidise ETS costs. It might indeed be less detrimental to revenues to pass through ETS costs incurred on price-sensitive markets that are subject to ETS to less price-sensitive markets falling within or outside the scope of ETS. Wit et al. (2005) and Lowe et al. (2007) do not think that ETS costs will lead to additional cross-subsidisation. According to them airlines are already cross-subsidizing up to a level that profits are maximised. ETS should, in general, not lead to a change in the optimal level of cross-subsidisation.

3.2.5 Unlevel playing field

Another argument for incomplete pass-through of ETS costs has to do with the fact that in certain markets, some carriers have to surrender ETS allowances, whereas other carriers may not. Take for instance the market between Dubai and New York. KLM operates this route via its hub within the ETS-area (Schiphol), which means the airline needs to surrender ETS allowances for both flight legs. A direct flight operated by Emirates on the other hand, does not fall under the ETS regime. On this route KLM might therefore not (completely) pass through the ETS costs as it might harm its competitive position. According to Bloomberg (2011) the number of such routes is however relatively small (around 8 percent).

4. Conclusions

From this paper, we may conclude that the pass-through strongly depends on the type of cost increase and market conditions. In monopolistic markets, a large part or all of a price change may be passed through, depending on the shape of the relation between prices and demand. In more competitive situations, sector-wide cost changes may also be passed through to a large extent, but not fully. In these competitive situations, cost changes which only affect one competitor will only be passed through to a small extent.

Airlines which operate in both competitive and non-competitive markets, may use the non-competitive markets as a 'cushion' to partly absorb cost increases. Therefore the pass-through in non-competitive markets may be higher than in competitive markets. Another way to partly absorb shocks may be to strive for cost reductions, especially with respect to inputs of which the costs have risen. At slot congested airports where the airline is able to capture the scarcity rent, a cost increase is unlikely to be passed through to the passenger. When the airline is not able to capture the rent in full, for instance when the airport has market power over the airline, the airline has an incentive to increase prices.

When cost increases are passed through, this is often done with some delay. Price changes lead to changes in demand, which may be served only by capacity changes. Capacity changes may be costly which implies that prices and therefore supply will only be changed when the cost increases will last long enough. In addition, due to the lumpiness of supply prices are only changed when an airline has aircraft types available that can efficiently serve the new demand.

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.

Empirical evidence with respect to the pass-through of cost changes within the aviation industry is limited. PWC (2005) have shown empirically that increases in fuel prices are almost fully passed through in ticket prices. Duplantis (2010) and Toru (2011) came to the same conclusion, but only when the higher fuel prices triggered capacity changes. Borenstein and Rose (2007) however found no empirical evidence that kerosene price shocks led to capacity changes.

Recently many studies on the economic effects of the introduction of ETS have assumed pass-through rates for ETS emission costs. These are all model studies; to our knowledge no empirical evidence on the pass-through of these costs exists. Many studies assumed a pass-through rate of 100 percent, based on the assumption that the aviation sector is highly competitive. Other studies, such as those by Forsyth and Gillen (2007) and Ernst & Young and York Aviation (2007) assume oligopolistic or monopolistic competition with pass-through rates well below unity.

Although a 100 percent pass-through is indeed likely under perfect competition, we argued that most aviation markets are not perfectly competitive, but can indeed be better characterised as oligopolies or monopolistic competition. In such markets one-firm cost changes will be passed-through for less than half and sector-wide cost changes are passed through by more than 50 percent, depending on the market conditions.

The literature also mentions other factors why ETS costs are not fully passed through in ticket prices. Many studies assumed that at slot congested airports, no pass-through is likely to occur. Empirical evidence however shows that cost increases are fully passed through at congested airports. This might be due to the fact that the scarcity rents are captured by the airport and not by the airline. Pass-through might also be lower than unity when airlines are in pursuit of market share. Several studies found that ETS costs are 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. But even in such markets there may be circumstances in which the pass-through of cost increases may be unwise as it could lead to capacity adjustments and therefore large demand effects due to the lumpiness of supply. Given their higher share of price sensitive passengers and a relatively low fare, low cost carriers are less able to pass through the complete cost increase than network carriers. As price sensitivity differs between markets, there is scope for airlines to cross-subsidise. In some markets airlines are able to evade ETS costs. Competitors unable to evade these costs might decide to not fully pass through the costs to remain competitive.

The lack of empirical research might be explained by the difficulty to obtain and analyse ticket fare data. Airlines apply yield revenue management systems that automatically change prices based on many different factors such as: time before departure, prices offered by competitors, number of booked seats etc. As a result many different fare levels apply to passengers on the same flight. Even if detailed passenger data is available, it remains difficult to isolate the price effects of a cost change given the diversity of prices and the vast amount of other factors that influence these prices. In addition, the cost changes themselves are not always easy to measure. Airlines for instance hedge fuel costs, which protects them against rising prices for commodities such as oil by locking in a price for fuel. This means that market prices do not necessarily represent the actual price paid by the airlines. Cost increases may also be an incentive for airlines to take certain services out of the base fare and consider them as ancillaries (checked-in baggage and meals for instance). In this case it may seem as if the cost increase had no or a limited impact on the base fare, whereas in practice the price of the product, including the ancillaries, has increased.

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Appendix A Pass-through of costs in non-aviation sectors

Gasoline, diesel and heating fuel costs

Burdette and Zyren (2002, 2003) found that oil spot price change are roughly completely passed through to gasoline and diesel retail prices within two to three months and that lag effects decrease over time. Meyler (2009) found similar results for gasoline, diesel and heating fuel in the euro area. The pass-through rate including taxes was found to be around 120 percent. This is consistent with the fact that the VAT percentage in Europe is on average 20 percent.

Emission costs in the energy producing sector

Empirical evidence on the pass-through of ETS costs is only available for the energy producing sector. The pass-through of ETS allowance prices onto power prices was clearly demonstrated in May 2006. At that time carbon prices dropped with 50 percent upon reports that some countries emitted far less CO_2 than expected. As a result electricity prices fell by € 5 – 10 per MWh in Europe (Boon et al., 2007). Empirical analysis of the Finnish electricity markets in the first 16 months of ETS showed that 75 to 95 percent of the price change in ETS allowances was passed through (Honkatukia et al., 2006).

Sijm et al.(2006) estimated that the costs for ETS allowances have been almost fully passed through to consumers (60-100 percent). The pass-through rate depending on the carbon intensity of the marginal production unit and various other market- or technology-specific factors. Alexeeva-Talebi (2010a) analysed 12 energy-intensive sectors in Germany and found less than complete pass-through (0-75 percent). The variation in the pass-through across sub-sectors is explained by industry characteristics including the import penetration, the level of product homogeneity, the market power of domestic firms and the price charged by foreign competitors in German markets. Alexeeva-Talebi (2010b) also investigated to what extent European refineries pass-through ETS costs. In the long-term full pass-through was deemed likely. In the short-run (within two weeks) pass-through rates differed significantly between countries, with the Netherlands, Germany and Sweden showing the highest pass-through 850-75 percent) and Portugal the lowest (25 percent). According to the IEA (2007) the costs of ETS allowances are passed through to power prices, but the rate at which this occurs depends on the specific market.

According to the European Commission (2006) companies are passing on the value of allowances through prices charged to consumers to the extent allowed by their competitive environment. Hence, companies operating within a market where all competitors are covered by the EU ETS e.g. European power markets, have had the ability to pass on the value of an allowance to consumers, whereas companies operating within a market where only a proportion are covered by the EU ETS have had less freedom regarding this decision. Whether companies receive allowances free of charge or against payment does not make any difference to this cost pass through decision. What really matters is whether companies are all equally exposed to the policy in question. When allowance costs are passed-through to consumers and yet some or all of those allowances have been received for free, the issue of

"windfall profits" arises. Since the EU ETS will be covering *all* aircraft operators operating on covered routes, aircraft operators would be expected to be able to pass on the value of an allowance to consumers.

Interest rates

Studies broadly show that changes in official and/or money market rates are not fully reflected in short-term bank lending rates to enterprises after three months, but that the pass-through is higher in the long term. De Bondt (2002) shows that for the euro area the pass-through of changes in market interest rates to bank deposit and lending rates within one month is at its highest around 50 percent. The interest rate pass-through is higher in the long term and notably for bank lending rates close to 100 percent. The empirical results also suggest a quicker retail interest rate pass-through process since the introduction of the euro. These findings could be an indication of an increase in the prevailing competitive forces, i.e. the degree of competition faced by banks and the interest rate elasticity of the demand for retail bank products, and/or a decrease in switching and asymmetric information costs in the different segments of the retail bank market in the euro area.

Exchange rates

A substantial body of empirical work shows that exchange rate movements lead to less than proportional increases in traded goods prices; and much of the price response occurs with a substantial delay (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). Recent theoretical work has suggested a number of potentially important factors in explaining incomplete pass-through. First, in oligopolistic markets, the response of prices to changes in costs depends both on the curvature of demand and on the market structure. Second, local costs may play an important role in determining pass-through. Local costs drive a wedge between prices and imported costs that is unresponsive to exchange rate fluctuations. As a consequence, if local costs are large, even a substantial increase in the price of an imported factor of production could have little impact on marginal costs. Third, price rigidity and other dynamic factors have the potential to contribute to incomplete pass-through.

Asymmetry

Numerous studies have examined, at an empirical level, whether prices incorporate cost increases more rapidly than decreases in many markets. Many of these studies have focused on the market for gasoline. The empirical results on the existence of asymmetries in gasoline prices 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), Ye et al. (2005) for instance found evidence for asymmetric price reactions in the gasoline market. Other studies, such as those by Bachmeier and Griffin (2003), Balke et al. (1998), Godby et al. (2000), Meyler (2009), Norman and Shin (1991) and Shin (1994) find no evidence for asymmetry.

The use of different methodologies, models, frequencies and periods of data, and the application to different countries, may be behind this heterogeneity of results. In more recent data sets it is more difficult to find evidence of price asymmetry. Another important element is the segment of industry being analysed; while the first segment of the industry is less likely to show asymmetry, the last segment (the relationship between the wholesale price and the retail price) has a greater possibility of showing price asymmetries. Quantity and quality of data play an important role too. Studies that have a greater number of observations are less likely to find price asymmetries. However, studies that use aggregate data, either geographically (using averages of large geographic areas) or temporally (monthly averages) are more likely to find asymmetric behaviour. The estimator used is equally significant (Perdiguero-García, 2010).

Empirical results for other markets are also available. Peltzman (2000) analysed 77 consumer and 165 producer goods and finds that output prices tend to respond faster to input price increases than to decreases. Leibtag et al. (2007) found robust evidence that coffee prices respond more to increases than to decreases in costs and Zachmann and Hirschhausen (2008) have shown that EU ETS emissions prices are passed through asymmetrically to electricity futures prices in Germany.

Neumark and Sharpe (1992) and Jackson (1997) support the notion that weakness of competition underlies price asymmetries. Peltzman (2000) finds no relationship between the degree of asymmetry and proxies for market power/imperfect competition. Nor does he find a relationship with inventory costs and menu costs.