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Strategies for managing risk in a changing aviation environment

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1. Introduction

The aviation industry is entering a new era in part due to two major issues. The first issue involves the increasing interest in the perceived environmental damage caused by transportation in general and by aviation in particular. The second issue involves the impact of multiple exogenous shocks such as the financial meltdown of 2008 as a result of which the aggregate airline industry profits of the past seventy years, which were admittedly marginal, were completely wiped out. Fig. 1 presents the data drawn from the Air Transport Association (2010). The variability of the exogenous shocks on airline demand levels has been increasing at a rapid pace hence the need to develop strategies for all stakeholders in the aviation sector. A major risk to the sustainability of the aviation system is that legal principles rather than economic rationality will prevail such that competition and good managerial leadership are swamped by market distortions. Understanding the markets, removing barriers to both entry and exit and encouraging competition on all links of the aviation sector leads to innovation and internalization of the inherent risks of volatile demand, economic cycles and climate change. Deregulation in the airline sector led to the development of a new breed of carriers that has in turn increased consumer surplus. Corporatization and privatization of airports led to a substantial increase in alternative revenue streams at airports which improved both producer and consumer surplus.

On the other hand, distortionary subsidies given to airframe manufacturers led to the development of aircraft that are not financially viable, such as Concorde and the A380 (Gellman et al., 2004).

In this article we discuss potentially fruitful strategies that may aid the airlines, airports, airframe and engine manufacturers and their first tier suppliers as well as those bodies governing the industry. These strategies need to provide a cushion whereby companies can reasonably handle the risk of fuel price instability, the introduction of carbon cap and trade regulation, the need to finance airport infrastructure, air traffic management systems, aircraft and other assets, the competitive inequalities drawing from subsidies across the globe at various levels of the supply chain and the effects of increasing ad-hoc consumer protection laws. The industry is dynamic and in 2010 returned to growth. Pro-active strategies are needed to ensure that further growth is viable in an economically, politically and environmentally sustainable manner since the alternative will involve regulation and a reduction in overall social welfare and mobility.

2. Airlines

Most airlines provide a scheduled service over which supply and demand must be carefully balanced, especially in light of the exogenous shocks that have substantially impacted demand in the short to medium term such as the explosion of the dot-com bubble in 2000, the security implications of September 11th 2001, the Severe Acute Respiratory Syndrome outbreak in 2003 and the United States housing price bubble of 2007 that led to the current recession felt in many parts of the world. The effects of these
downturns will continue to be felt at airlines that fail to adopt a plan to replenish, upgrade and perhaps increase their fleet in order to account for the longer term, underlying growth pattern that is likely to transpire over time. Good management would appear to be one of the most important elements of building and maintaining a successful airline and prudent aircraft purchasing decisions are at the epicenter of this approach (Tretheway and Waters, 1998; Government Accountability Office, 2006). Furthermore, management must consider direct risks to the supply side, including for example the future price of fuel as well as the pricing and/or regulation of environmental externalities such as global greenhouse gas emissions, local air pollutants and noise.

This section first discusses the issues of managing a heterogeneous customer base and the life cycle of the airline market in section 2.1, the issues of achieving profitability in section 2.2, the approaches to handling competition in section 2.3 and the remaining supply side strategies in section 2.4.

2.1. Managing demand

Aviation is often treated as a discretionary service in comparison to other forms of transport such as daily trips to work, which leads to volatility and seasonality of demand. However airlines do provide mobility which is unique in longer haul markets and spans heavily business oriented destinations (e.g. Belgium and Shanghai), almost purely touristic hotspots (e.g. Hawaii and Las Palmas) with the majority of origin-destination pairs a mix of the two to varying degrees. Overall growth in demand has been decidedly positive over the longer term in line with the different stages of maturity of the industry around the globe and the respective income levels.

Business travel demand appears to be shrinking which is a process that began as far back as 1999 (Mason, 2005) and has continued as a result of the current financial crisis, with companies searching for alternative forms of communication or at the very least, economy class tickets (Cobb, 2005). Consequently, airlines need to encourage business passengers to move to the front of the cabin by maintaining frequency where reasonable, improving frequent flyer programs and attracting long term corporate travel agent agreements. The standard scheduled carriers have lost some business demand to the business jet market, although this is obviously limited to the extremely time constrained with a substantial willingness-to-pay (Mason, 2007). Private aircraft and related traffic have so far avoided most of the security regulations that the legacy and low cost carriers must handle, which contributes a reasonable amount of additional time to a trip particularly in the shorter haul markets.

Leisure travelers choose holiday purchases given their discretionary income levels which have been reduced since 2007. This passenger type is the most price sensitive, which has encouraged airlines to unbundle their product, providing the airlines with the ability to further price discriminate whilst arguably allowing passengers greater choice (Brons et al., 2002; Clemons et al., 2002; Bilotkach, 2010). Airlines must utilize their existing staffing levels and fleet of aircraft at least in the short term, which has led to a heavy reliance on revenue management technology.

The heart of the airline business lies in attracting the two consumer types, namely the business passenger interested in high levels of frequency and less so the airfare as compared to the leisure passenger who places much greater emphasis on fares (Proussaloglou and Koppelman, 1995; Adler, 2005; Adler et al., 2010c). Ignoring one type at the expense of the other would appear to be extremely perilous. Despite the high margins on business travel, a scheduled airline model catering specifically to this type of consumer does not appear to be viable, see for example Maxjet, Eos and Silverjet, pure business class airlines serving transatlantic routes, all of which failed for bankruptcy in 2008. One of their major issues were the problems of connectivity, as none of the airlines developed a web of interline or codeshare services which is so important to beyond or behind gateway travel (Holloway, 2008). Charter carriers serving the pure leisure market also appear to be a waning business model as the low cost scheduled carriers take their place in maturing airline markets (Gillen, 2006). For scheduled service, the high frequency demanded by business consumers can only be served if the remainder of the aircraft is filled with a sufficient number of passengers willing to at least cover the marginal cost of the seats. Relatively high frequency ensures a disproportionately higher market share (Swan, 2007; Belobaba, 2009) which is only worthwhile if the yield at the very least covers the average costs of the flight, including the cost of capital. Airlines in the more mature, standardized markets achieve competitive advantage through lower costs. It may also be true that on longer flights (more than five hours), passengers are more willing to pay for additional comfort which would permit the differentiation strategy to survive and prosper.

Strategies also need to match the life cycle of the market in which they exist. Until now, airlines have placed extreme emphasis on maintaining or increasing market share rather than profit potential and origin-destination yields. It would appear that the American domestic market, currently the largest aviation market in the world, has achieved a level of maturation such that market growth is flattening out. Whilst the European Union is moving towards saturation, the South American, Far East and
intercontinental markets are all a long way from maturation. Furthermore, the African and Middle Eastern markets have yet to begin their exponential growth rates (Swellbar and Belobaba, 2009). Consequently, low cost strategies in the United States and European Union domestic markets appear to be the most profitable strategy given the current market life cycle, whereas the differentiated strategy would appear to be more profitable on the intercontinental routes and in regions that have yet to develop their markets more fully.

2.2. Managing profits

It is extremely important for airlines to analyze the markets not as short-run revenue maximizers rather as long-run profit maximizers, in which case the reasonably substantial fixed costs would be covered such that a normal return on capital could be achieved. Gillen (2006) argues that the legacy carriers focus on profitability at the network level rather than individual links which has lead to managerial myopia, excessive network size and severe price discounting. Tretheway (2004) argues that the low cost carrier pricing policy differs subtly but importantly from that of the legacy carrier revenue maximization procedure. Whilst the low cost carriers require all flights to fully cover allocated costs thus ignoring the issue of transfer passengers, the legacy carriers separate the decision making apparatus such that in the first stage, capacity choices are made and in the second stage, yield management systems maximize revenue given the first stage decisions. This separation in decision-making reduces the pricing policies to short term decisions which has resulted in declining yields and a failure to cover the capital costs needed to replenish a fleet.

Proussaloglou and Koppelman (1995) analyze air carrier demand and demonstrate that new carriers with limited frequent flyer programs must provide substantially lower fares or a superior level of service in order to compete effectively with incumbents. However, the recent erosion of the gates required to ensure successful revenue management models has left the legacy carriers with a reduction in fare classes, for example as a result of the disaggregation of return fares into single unidirectional tickets that has occurred due to low cost carrier policies (Cobb, 2005). Following Porter’s competitive strategy approach (1980), we argue that the likely market outcome that would permit airlines to achieve long run profitability suggests that low cost carriers should serve the domestic or regional markets whereas legacy carriers should continue with their differentiated approach on the intercontinental, longer distance routes. This would permit the legacy carriers to reduce the variety of aircraft currently required to serve greatly differing stage lengths, in turn reducing maintenance and training costs and increasing the productivity of the remaining fleet. Codesharing across the two business models would be a logical next step and although low cost carriers have not generally participated in interlining or codesharing, examples do exist such as Virgin Blue and United (2002–2008) then Delta (from 2008 onwards) and Westjet with Southwest for a short period and Cathay Pacific (from May 2010).

2.3. Managing competition

Another important set of strategies available to airline managers to better manage risk include choices with regard to interlining, codesharing, joining an alliance or merging with complementary partners or rivals, subject to government anti-trust regulation. Interlining became a feature of the airline landscape as a result of the Chicago Conference held in 1944 which permitted an airline to sell a single ticket to a consumer despite the fact that the origin and destination were not directly connected by the carrier, rather passengers would need to change both planes and airlines on the single itinerary. This was advantageous to the consumer who would not need to carry baggage at the connection and was organized between the airlines through the International Air Transport Association (IATA). The IATA conferences organized the airlines, enabling them to reach pricing decisions per region and to subsequently share interline revenues according to the geographical distance each carrier provided per itinerary. Codesharing first appeared in international markets in 1985 (Gellman Research Associates, 1994). Collaboration between airlines was at first designed in order to offer the international passenger a “seamless” travel experience by minimizing some of the inconveniences of traditional interline itineraries. Benefits to consumers of codeshares over interline itineraries include agreements on standardized levels of service, access to airport lounges and frequent flyer programs. For the suppliers, codeshares based on block space or free sale agreements encourage the airlines to consider the issue of double marginalization but also lead to closer associations and a softening of competition, such that the agreements are a somewhat double edged sword. The Transportation Research Board (1999) noted that 70% of global alliances include provisions for codesharing. 30% include provisions relating to sharing of frequent flyer programs and 15% also include agreements to share facilities such as catering, training, maintenance and aircraft purchasing.

The web of codeshares that form the basis of an alliance help airlines to better handle risk, permitting a reduction in capacity during bear markets and faster response to unexpected short-term changes in demand. Gillen (2006) argues that along with the development of hub-and-spoke systems, domestic fees have contributed to the development of international alliances in which one airline feeds another hence utilizing the capacity of both to increase service and pricing. Codesharing began as a pure marketing exercise but has now become an important element for both suppliers and customers. The supplier offers a greater network span and enjoys economies of scope and density. Consumers avoid the issue of double marginalization that arises when required to purchase two or more tickets from different vendors, enjoy reductions in schedule delay and reduce complications arising from delays particularly on the first leg of an itinerary. Adler and Hanany (2010) demonstrate that consumer welfare on thin origin-destination markets is higher with code-sharing airlines than purely competing carriers. Consequently, codesharing increases the level of service provided to the consumer.

Aviation should develop into an industry in which reasonable levels of profit are achievable throughout the economic cycle. Under the current regulatory regime, cross-border mergers are not permitted since foreign ownership rights are curtailed to varying degrees, except in the Australasian domestic markets. However, as demonstrated in Adler and Smilorwitz (2007), airlines would always prefer to merge based on economic considerations, drawing from improved cost efficiency and subsequently higher profits. Indeed international gateway choice would change were mergers to be permitted. Adler and Hanany (2010) also demonstrate this point but purely from the demand side perspective whilst the cost advantages are ignored. Consumer preferences for higher frequencies and home carrier bias permit airlines to achieve their highest profits under mergers although to some extent at the expense of consumer surplus.

2.4. Managing supply side risks

Aircraft competition may not always be acting on a fair playing ground which is a sign of supply side risk. Airlines in the Middle East, including Emirates, Ethihad and Qatar, have a growing presence in the aviation markets and enjoy a business environment to which
other airlines do not have access. According to O’Connell (2006), Emirates enjoys zero corporate tax under the United Arab Emirates’ laws, extremely low airport charges at its Dubai hub since the Chairman of the airline is also minister in charge of civil aviation governing the airport, an uncongested hub that reduces fuel costs, low labor costs and a labor force that is not permitted to join a union or strike. Altogether, this contributes to an estimated 40% cost advantage over British Airways and a 45% advantage over Air France/KLM (O’Connell, 2006). Were the Middle East aviation market to develop alongside regional stability and liberalization, Adler and Hashai (2005) predict that Cairo and Tehran are likely to develop regional hubs with Istanbul and Riyadh emerging along with the prosperity of the region based on geographic and demographic considerations. Current transport investments also suggest that the Dubai region is succeeding in its attempt to develop a major hub system connecting the continents of North America, Europe, Africa, the Far East and Australasia via the Middle East.

The growing lack of trained pilots is another issue of note to both airlines and aircraft manufacturers. As the number of unmanned aerial vehicles grows globally (The Economist, 2009), fewer fighter pilots are being trained, leaving an insufficient number to subsequently enter the civilian industry once their military careers are completed. Embraer has announced that within the coming decade it plans to build a single pilot certified aircraft (Flightglobal, 2010) and it is likely that pilotless cargo aircraft will be in use within this timeframe as well. We predict that pilotless passenger aircraft are likely to enter the skies within two decades, once the next generation of computer-centric air traffic management systems and avionics enter the market. In the meantime, the burden to push for increased funding of pilot training appears to lie on the shoulders of the Pilots Association and trade associations, such as the Air Transport Association and Regional Airline Association.

Finally, the climate change debate is gradually pushing all sectors of society to measure, manage and subsequently reduce their carbon footprint. The aviation sector is slowly feeling this pressure too with New Zealand and the European Union at the vanguard of this process. The pressure on aviation has more to do with the prominence of air travel in society today than with the real contribution of aviation to global warming, since trucking and cars are a far more important contributor. New Zealand introduced an emissions trading scheme (ETS) in 2010 that extends only to domestic flights and can be applied to either the petroleum supplier or the airline. The New Zealand government intends to reduce carbon emissions to 1990 levels. Scheelhaase et al. (2010) discuss the likely impact of the European Union (EU) emissions trading scheme currently expected to begin implementation in January 2012, which is to be applied to both domestic and international flights. Scheelhaase et al. argue that the EU-ETS will probably provide a competitive advantage to non-EU carriers whose short-haul, less environmentally efficient flights are not within the EU jurisdiction. Forsyth (2008) argues the opposite by suggesting that the free permits would provide a financial advantage to those receiving them, although the impact is not expected to be substantial.

The question then remains as to whether other regions of the world will follow suit and set up emission trading schemes or introduce carbon taxes in order to internalize the environmental externalities. In addition, various individual airports have gradually introduced night flight curfews and noise charges as well as local air pollution charges covering both nitrogen oxide and hydrocarbon (Scheelhaase, 2010) over the past decade. Governments need to decide whether they are interested in dampening demand to reduce global warming or push for innovation such that each flight pollutes at lower levels hence permitting “green growth”. If the latter has a greater priority, then subsidizing research and development in this area is a necessary and currently under-utilized component. Finally, it would probably be extremely beneficial to the various players in the aviation supply chain were the economic instruments chosen, whether restrictions, charges or taxes, to be applied equally across the globe and in a harmonized manner.

3. Airports

Airports have been changing as a result of privatization and corporatization, the deregulation of airline markets regionally and inter-continentally and the development of the low cost carrier model which demands different services from the secondary airports that they generally serve (deNeufville, 2008). Airports in many parts of the world are no longer viewed as public utilities rather as private enterprises aiming to maximize shareholder value and profits from a fixed facility (Adler et al., 2010b). The trend to privatize airports began in the United Kingdom in 1987 with the flotation of the British Airways Authority, a company that owned and managed seven airports, three of which were located in London. The recent forced sale of Gatwick airport has the intended aim of encouraging competition among the airports of London. Within the London catchment area, BAA now owns and runs Heathrow and Stansted, Global Infrastructure Partners owns and runs Gatwick and London City whilst Luton is owned by the local council and run by a private company.

As airports have required infrastructure investments beyond the budgets of local and federal governments, the airports have gradually been privatized in Europe, South America, South Africa, Asia and Australasia. Perhaps surprisingly, airports in the United States are owned either at the state or local authority level and are operated by divisions of municipal governments or airport authorities. However many of the sub-processes at American airports are managed by private companies and a mere 10–20% of the employees on the airport site are directly employed by the government authority (deNeufville, 1999). Until the 1980s, much of the investment in airport infrastructure drew from the Airport Improvement Program, a Federal Aviation Authority based fund. The fund has gradually reduced in importance, particularly at the larger hub airports, and has been replaced with direct passenger facility fees and the issuing of bonds often underwritten by the relevant hubbing airline (Odoni, 2009).

Whilst many airports remain natural or locational monopolists, for example in small countries with little to no domestic traffic, others operate in competitive markets as a result of the deregulation of both the airlines and airports (Starkie, 2002). Trettheway and Kincaid (2010) define airport competition to include local demand located in overlapping catchment areas e.g. multi-airport cities, connecting traffic served by hubs, cargo traffic, alternative modes and destinations. Barrett (2000) argues airport competition is a new element of European aviation as a direct result of liberalization, whereby airports within one hour ground surface access are in direct competition for their respective catchment area, as occurs in multiple cases in France, Germany and the United Kingdom. Hooper (2002) argues that governments in Asia may rely on competition to impose a significant degree of discipline on airport managerial behavior. Adler and Liebert (2010) demonstrate that competition for connecting passengers and/or over catchment areas appears to be sufficient to encourage cost efficiency independent of ownership form or economic regulation. However, apart from Australia and New Zealand, airports around the world remain price regulated. According to Fu et al. (2011), the light handed regulatory approach of Australasia in which price monitoring replaced formal regulation has not been successful, mostly due to the lack of competition inherent in a system with large distances.
between airports. Consequently, it would appear that competition is sufficient to ensure that airports are cost efficient but without it, independent of ownership form, some form of economic regulation is necessary. Such regulation would reduce the likelihood of litigation as has occurred on multiple occasions in Australia with Virgin Blue, currently the second largest Australian airline. Adler and Liebert (2010) also demonstrate that privatized airports operating in a competitive environment may still require economic regulation in order to avoid excessive pricing in comparison to their unregulated, public counterparts operating in a similar environment.

Strategies for airport managers therefore need to account for ownership form. In section 3.1 we discuss strategies for the shorter term timeframe and in section 3.2, we discuss size and pricing policies relevant to the longer term issues identified.

3.1. Short term strategies

In the short term, airport managers may be interested in maximizing variable factor productivity, given a fixed airport capacity. This is particularly true for privatized airports and those who are price capped under an inflationary less efficiency formulation which permits the airport to retain productivity gains beyond the minimum level required by the regulator. Variable factor productivity includes labor, supplies and materials and outsourcing costs and quantities, given passenger and cargo throughput, air traffic movements and non-aeronautical revenues. Shorter term decision making includes searching for a balance between in-house production and outsourcing activities. Partial analyses of subprocesses such as baggage handling and passenger flow through terminals may also help managers to highlight bottlenecks in the system. Benchmarking good practice is crucial to effective management and public disclosure requirements, an approach adopted in Britain and Australia (Hooper, 2002), is an important missing link in encouraging productive efficiency. A uniform system of airport accounts similar to that of the International Civil Aviation Organization (ICAO) airline reporting practices would be helpful to both airport managers and regulators alike. Indeed, there are no generally accepted accounting practices even for airports within a single country which means that the capital input mix cannot be analyzed. The academic literature contains many potentially useful methodologies for benchmarking processes, such as stochastic frontier analysis (Oum et al., 2008; Martin et al., 2009) and data envelopment analysis (Sarkis and Talluri, 2004; Adler et al., 2010b) which could be applied were comparable data to be made available. Transparency in data collection would also encourage analyses of dynamic efficiency which is extremely important in an industry with lumpy and large fixed costs.

In the medium term, uncongested airports with low capacity utilization need to reduce their asset base and/or increase their customer base. To attract greater output, either in terms of passengers or cargo, may require offering lower charges for new destinations served for the first couple of years of service or unbundling the airport services, thus permitting airlines to choose varying levels of service according to their desires. Congested airports require different managerial policies including expanding capacity at the margin wherever bottlenecks are identified and incentivizing airlines to use off-peak slots through pricing. The ICAO governs the rules for landing fees on all international flights and requires that charges do not exceed the full cost including a return on capital which is needed to provide the facilities and services. A revenue neutral congestion pricing policy would remain within the guidelines of the ICAO and may result in negative prices for off-peak air traffic movements but this should improve capacity utilization without being discriminatory. Alternatively, larger planes could attract price reductions which again would provide incentives for airlines to maximize capacity utilization in line with social welfare optimization. Additional medium term strategies include actively identifying ground access improvement opportunities, such as high or higher speed train service, or improved road access which may widen an airport’s catchment area.

3.2. Long term strategies

The longer term issues are the most difficult to solve since they generally require capacity expansion or reduction, both of which are very difficult to undertake. Barriers to expansion include political interests, noise and environmental restrictions, the time and expense involved in receiving planning permission, not in my backyard syndrome and the lack of active management interest, likely to be more relevant at public airport authorities. In addition, there are sufficient examples of airports who undertook the risk and expense of expansion only to be underutilized afterwards, such as the City of Dayton that decided to build a hub at the behest of U.S. Air which then drastically reduced its services. American Airlines behaved similarly at Raleigh and Nashville and, after acquiring Reno, left San Jose airport in the lurch to a large degree. In order for an airport to be cost efficient, it is necessary to utilize resources carefully, which generally leads to congestion and the need to deal with this issue fairly with respect to passengers, airlines and the environment. The toughest issue for airport managers is the lack of signals inherent in a system whereby congestion and delay are not priced. The lack of congestion pricing incentivizes airlines to increase frequency and reduce aircraft size even during peak periods. Indeed, the trend in airplane size in the United States has been on the decline since 1985 because smaller aircraft achieve shorter turn-around times hence higher utilization, consumers value higher frequency which is reflected in airfares, smaller aircraft produce marginally lower levels of noise which is relevant at hub airports with aggregate noise constraints and congestion pricing which is missing from the equation (Swan, 2007). Without peak pricing in the United States or scarcity pricing in Europe under the slot allocation system, from where do the signals come to expand or define optimal capacity levels? As Levine wrote in 1969, the existing pricing system fails to guide investment so as to achieve the appropriate mix and level of output with a minimum investment of resources and the same could be said today. Congestion pricing and the direct valuation of slots would appear to be strictly preferable to the current system of rationing defined in the form of slot allocation regulation in Europe and Department of Transport brokerage in the United States (Johnson and Savage, 2006). One could argue that were congestion fees collected for the transparent purpose of building or expanding specific bottlenecks at an airport, such charges would indeed be in line with the ICAO policy mandate.

Slot allocation policies exist to ensure that delays in air transport are not excessive and appear to be effective when comparing American and European delay outcomes (Forsyth, 2007). Indeed, the lack of slot allocations at American airports has led to the development of a ground delay program operated by air traffic management through the Federal Aviation Administration (FAA). However, the bartering involved with this system prevents new entrants from entering congested airports hence provides an economic advantage to legacy carriers. Adler et al. (2010a) discuss the slot allocation issues in the greater Tokyo region which permit the producers to extract surplus from consumers, to the extent that an aggressive low cost carrier is not capable of increasing competition either domestically or regionally. Czerny et al. (2008) summarize much research that promotes the use of auctions as an alternative form of scarce resource allocation, however it is
rather unlikely that the incumbent airlines would readily agree (see Sentance, 2003 for an incumbent airline’s response). The lack of clear legal ownership with respect to landing rights is an issue that needs to be solved in order to allow airports to efficiently match supply with demand. Permitting slots to become a tradable asset would substantially improve the capacity allocation issue although regulation would still be necessary in order to ensure that airports are not reregulating the airline sector. Whilst slot allocation is not an issue in the United States where a first come, first served policy exists, gate allocation acts as a barrier to entry instead (Dresner et al., 2002). Gate allocations in the United States are often accompanied by a 15–30 year lease contract in order to allow airports to issue bonds that fund the expansion. Despite deNeufville’s (1999) argument that the collaborative approach in the United States has led to a better airport system than other areas of the world, controlling access to busy airports acts as a barrier to entry for airlines, which severely curtails competition and the positive impacts of deregulation.

4. Airframe and engine manufacturers

Over time, many airframe manufacturers merged, exited or failed to the point that two major markets remain: large airframe and regional jet manufacturers. The large airframe market currently consists of two firms, the European Airbus and American Boeing companies. The duopolists have chosen to compete head-on, with each firm producing a range of aircraft in direct competition, such as the A380 and Boeing 747-8, the A350 and B787 and later variants of the B777, and the smaller A320 with the B737. To some extent the B787 is also in competition with the A380 over certain routes. For example, in the American-Japanese market, the A380 may well serve the JFK-Narita hub-to-hub market given the level of congestion at both airports whereas the B787 may serve the JFK-Nagoya or Newark-Nagoya market as a way of avoiding at least one major hub and providing improved service to passengers through a direct itinerary.

In the regional jet market, Brazilian Embraer and Canadian Bombardier are the two major players but they may be competing with manufacturers located in Russia, Japan and China shortly. Small airframe development has benefitted from subsidies to customers in the form of low interest loans from their respective governments in order to support development of aircraft of up to 100 seats, despite 2000 and 2001 World Trade Organization (WTO) rulings that this should not continue. Recently Bombardier, which is subsidized by the Canadian government, announced the development of their C series which will ultimately accommodate 150 seats. In an unusual move, Airbus and Boeing joined forces and jointly argued before the WTO that such financial subsidies should be limited to 100 seat capacities, if not stopped entirely. However, both the Japanese and Chinese governments provide subsidies to companies developing aircraft components within their respective borders that encouraged outsourcing by both Airbus and Boeing.

Another form of subsidy occurs when new aircraft require a change in the capabilities of airports and the cost is borne by the airports rather than the relevant airframe manufacturer. In the 1960s, McDonnell Douglas began producing the DC10–10 but the conditions for sale were that the New York airports could accommodate the aircraft, which required strengthening the taxiways and widening the runways. The New York Airport Authority argued that the costs involved were prohibitive and the McDonnell Douglas Company, after reducing the costs through a radical redesign, paid for the changes necessary. Multiple airports are currently under expansion in order to accommodate the A380, but these costs are being borne by the airports, which represents a distortion in the airframe market. Clearly, subsidies are unlikely to disappear despite WTO rulings and it would appear that the appropriate policy would be to encourage discussions and reach agreements across countries in order to limit the imbalance such distortions create. An example of the results of such discussions includes the 1992 E.U.–U.S. agreement that calls for a Critical Project Appraisal before permitting any subsidization of the research and development of airframes. The agreement called for the repayment of direct government support over a period of 17 years beginning from the date that the first state aid was received. However, as argued in Gellman et al. (2004), such an appraisal of the A380 was never undertaken and had this been the case, it is unlikely that the aircraft would have been produced. Hence, it is insufficient to reach such agreements unless a legal entity exists that can uphold the clauses therein.

Other expensive inputs such as the engines and avionics are manufactured by various companies located in Europe, South America and North East Asia. In the parts market, under current American regulation, the original equipment manufacturer controls the supply of parts for aircraft still under production. Alternative producers do not receive FAA approval and their parts are tagged with the negative connotation of ‘bogus’ parts. A similar situation occurs with engine parts but in this market, alternative producers have tried to receive approval from the FAA on the basis of ‘functional equivalence’. To date, functional equivalence has not been approved and the spare parts market is limited, ensuring high mark-ups which inflate airline input costs. Since the American policy with respect to the parts approval process is emulated globally, this issue crosses borders. We would argue that if a comprehensive functional equivalence test can be developed and the testing was undertaken by an independent agency, providing approval for these parts would break the current stranglehold in this first tier market.

Another major risk to the aviation sector is the continuing fluctuations in the price of oil. It is unlikely that a battery powered aircraft engine will be developed in the near future due to issues with the weight and size of the batteries available under current technological capabilities. Consequently, aviation is likely to continue to be dependent on oil for the foreseeable future. Two types of government action may be helpful in this regard. First, it would appear to be important to begin regulating oil speculation in order to prevent oil upside spikes that caused the massive changes in the price of oil inputs mid 2008. Second, were the United States, United Kingdom, France, Germany and Japan to agree, it would be possible to break the stranglehold of the OPEC cartel on current oil prices. The current price of jet fuel has little connection to the cost of production. The relevant governments could restrict oil imports if prices were deemed unacceptably high. Independently, these governments could subsidize research and development into new, cleaner technologies that would encourage universities and the private sector to explore ways of reducing greenhouse gas emissions. Current promising avenues include the use of lithium aluminum or composite materials to reduce the weight of the aircraft and the development of alternative fuels, such as bio-fuels which reduce carbon dioxide based on the full life cycle approach. Government funding, such as the European Union’s Clean Sky Joint Technology Initiative, appears to be necessary at this point in time due to the high risk involved in this research. It is not yet clear whether Camelia or algae have the potential to be grown in sufficient quantities to serve the market for bio-fuels without displacing land needed for food production. Finally, operational research and development could encourage air traffic management systems to search for greener routings and manufacturers to further improve aerodynamics and engine efficiency.

Noise remains a major issue, particularly in regions with high density populations such as Europe and Asia but also at 29 out of
the 50 busiest airports in the United States (Girvin, 2009). There are examples of airports for whom capacity restrictions are defined by noise regulation rather than their physical capabilities such as Schiphol. Brueckner and Girvin (2008) argue that continuing to examples of airports for whom capacity restrictions are de maximize social welfare. Swan (2007) argues that the use of tax, pressures stakeholders to attempt to mitigate the issue hence limit cumulative noise at airports or equivalently, to charge a noise initiatives are currently being funded including NASA `development needs to consider all elements of the aviation sector. Two initiatives are currently being funded including NASA’s ‘Quiet Aircraft Technology’ program financed by the American government and the Silent Aircraft Initiative undertaken at the Cambridge-MIT Institute together with industrial partners, mainly funded by the British government. Due to the trade-offs between reductions in local air pollution, noise in the vicinity of the airport catchment area and global greenhouse gas emissions affecting climate change, one of the major tasks of the new decade will be to strike the correct balance.

5. Regulators

In this section, we discuss the risks that exist within each of the links of the aviation industry and the potential strategies available to regulators to counteract the issues. We discuss the on-going process of deregulation of the airline markets in section 5.1, the conditions under which airport regulation continues to be a necessity in a gradually privatized and corporatized airport industry in section 5.2 and the issues arising as a result of the changes in ownership form of the air traffic control sector in section 5.3.

5.1. Airline regulation

Over the history of the aviation industry, both airlines and airports have been heavily regulated and subsidized. In the United States, airlines have always been in private hands but until deregulation in 1978, the Civil Aeronautics Board chose the carriers to serve specific markets and their respective airfares. After deregulation, American carriers were free to fly wherever they chose in domestic markets but international services remain regulated according to reciprocal bi-lateral agreements. The American government has gradually opened the skies by encouraging multi-laterals which led to the horizontal Open Skies agreement with the European Union in 2007, effective as of 2008. However, American airlines are still protected through the standard Chapter 11 bankruptcy proceedings under which airlines restructure their debt and operations but continue to serve their markets (Button, 2009). Whilst Chapter 11 proceedings are not specific to the aviation sector, the impact of this law is to produce an effective barrier to free exit from the market. In the European Union, most airlines were defined as flag carriers up to deregulation in the Third Package of 1998 in which airline subsidies, which had been quite substantial up until that point, were no longer deemed acceptable. Whilst there remain a few state owned airlines, such as Olympic and TAP, the majority of carriers are now in private hands. The European Union and individual countries have permitted airlines to fail, for example Sabena and Swissair, however other airlines continue to survive due to either protectionist international bi-lateral agreements or subsidies, as has occurred in the cases of Olympic and Alitalia. The domestic Chinese airline market has been gradually deregulated with China Eastern Airlines listed on three stock exchanges in 1997, marking the beginning of the process. In 2002 there was a wave of airline consolidations resulting in the emergence of three large airline groups; Air China, China Eastern and China Southern with major hubs in Beijing, Shanghai and Guangzhou respectively (Zhang and Round, 2008). However, the Chinese skies remain relatively closed as the government continues to protect Chinese airlines from foreign competition. Southeast Asian liberalization permitted a wave of new entrants in the early 1990’s although many did not survive the regional economic crisis of 1997 (Hooper, 2005). The World Trade Organization has placed on their website a geographical tool that demonstrates the level of openness of bi-lateral agreements and awards each country a weightetd air liberalization index score based on the level of air freedoms permitted, ownership restrictions, pricing and carrier designations. New Zealand and Australia receive relatively high scores, the United States is somewhat lower and China’s score is close to the bottom of the scale currently.

In order to protect airlines on the grounds of security considerations and potential job losses, the United States currently limits all foreign ownership of American carriers to 25% of the voting shares and at least two-thirds of the Board as well as the Chair must be American nationals. The European Union limits foreign ownership to 49% of the airline’s shares. A second open skies agreement, signed in June 2010 but still requiring ratification on both sides of the Atlantic, aims to loosen airline ownership and control restrictions reciprocally but as yet the details have not been revealed. In 1994 the Chinese government began to permit foreign investment in Chinese airlines of up to 35% of registered capital, which has since been increased to 49%, although foreign owners may not purchase more than 25% of the voting stock (Zhang and Round, 2008). Similar restrictions exist in South America, Africa and Asia. Tretheway (2004) calls for the elimination of foreign ownership restrictions of air carriers and the permission for mergers across borders, arguing that national security benefits do not exceed the economic inefficiencies arising from the prevention of cross-border consolidation. The failure to permit consolidation is likely to result in either further bankruptcies or bailouts. New Zealand was the first to remove foreign ownership restrictions on domestic carriers and Australia followed suit in 1999. Indeed a multilateral open skies agreement (MALIAT) was signed in 2001 between Brunei, Chile, Malaysia, New Zealand and the United States in which the nationality clause was replaced with “the principal place of business and effective control” (Hsu and Chang, 2005).

As a result of the existing ownership restrictions, airlines currently unable to merge across borders have chosen to develop strategic alliances through the development of a web of codeshares which pools risk and increases network access. It would appear that codeshares have positive benefits for both consumers and producers alike even on parallel links and anti-trust immunity should only be necessary on thin routes (Adler and Hanany, 2010). Furthermore, bilateral agreements between two countries appear to be the worst of all worlds, limiting frequency and hiking prices at the expense of consumer surplus (Gillen et al., 2002; Adler and Hanany, 2010). Therefore, the most important strategy from the regulators perspective should be to open up the skies through multi-laterals. Cabotage, defined as the eighth and ninth freedoms of the air, would be another way to circumvent the archaic ownership rules. Conservatism has ruled to date, for example the Association of Southeast Asian Nations (ASEAN) have discussed opening the skies regionally for over a decade but still appear to be a long distance from achieving this goal (Tan, 2010), although the MALIAT agreement has shown that this is a distinct possibility.

Deregulation of the airline industry has served to highlight the importance of ongoing ex-post application of normal anti-trust
law. To protect the lower prices and higher frequencies that strongly support the argument that the aviation market is better off without regulation (Kahn, 1988), it is equally important to protect the premise on which competitive markets develop. Free entry and exit are the cornerstones of such a policy and prevent market distortions and inefficiencies. However, it would appear that both tenets are ignored in different geographical corners of the world. Free entry only occurs if there are neither bi-laterals protecting designated carriers nor restrictions on the freedom to land and take-off at the airport level. Within the Far East and European Union, almost all airports are slot controlled and many are highly congested, both of which present serious barriers to entry. Within the United States, slot controlled airports no longer exist, however gate constraints due to high utilization or exclusive use designations are proving to be real barriers to entry (Dresner et al., 2002). In order to support revenue bond financing of facilities, many of the larger airport operators have required airline tenants to lease gates and counter space for a period of up to thirty years and in some instances, dominant airline carriers have built their own terminals and subsequently retain complete control whether fully utilized or not (Cohen, 1983). Consequently, independent investment in airport gates, restrictions on minimum aircraft sizes during peaks and congestion or scarcity pricing are important policies to be considered. Priceless to say, the academic literature has discussed replacing the weight based landing charges with peak pricing for the last forty years but so far to no avail. Levine (1969) and Carlin and Park (1970) were among the first to discuss this issue. Daniel (1995) developed a bottleneck model and applied it to Minneapolis-St. Paul airport, arguing that by spreading the peak, the airport could increase air traffic movements by as much as 30%. A series of papers by Brueckner (2002, 2005) and Brueckner and Van Dender (2008) argued that at least some of the congestion is internalized by hub airlines, namely that which it imposes on itself, however this does not remove the need for peak pricing nor the need to ensure access for potential new entrants. Morrison and Winston (2007) argue that second-best, atomistic congestion charges would improve social welfare and significantly reduce delays at congested airports in the United States even if internalized congestion is essentially charged twice. Schank (2005) argued that peak pricing has so far been unsuccessful, citing three attempts at Boston Logan, the Port Authority of New York and New Jersey and the British Airports Authority. His main line of reasoning suggests that implementation is only acceptable and likely to stand in subsequent litigation if the airlines removed from the peak timeslots have the ability to move to an alternative, efficient time, which the American carriers flying into London in the early morning successfully argued was not the case in the subsequent court proceedings, or to alternative airports, which was not available in Boston. As Starkie (2008) noted, most airports are not necessarily congested rather demand is peaked over the course of a day which is currently not managed efficiently through the weight-based charges but is the current basis for deciding on the need to expand.

Free exit is the other single most important strategy for governments to consider. Ensuring that no company is "too big to fail" is equally applicable to the airline industry. If Chapter 11 and subsidies or bailouts permit airlines to survive rather than be liquidated, the creativity and strong managerial skills that were engendered in this market apparatus will fail. It is important to permit failure and bankruptcy in order to ensure that the best survive and profit with as few market distortions as possible.

Reregulating the airline industry is a perennial discussion that has been highlighted once again at the initiative of Oberstar and others in the United States congress recently (Lowy, 2010). A Government Accountability Office report to Congress in 2006 argues that such a move would likely reverse consumer benefits without saving airline pensions, such as those lost during the bankruptcy proceedings at United and US Airways in 2004. The report argues that the reduction in prices and increase in flight frequency and competition which have benefited consumers to varying degrees would be derailed by reregulation. Poole and Butler (1999) argue that the serious problems remaining in the aviation sector draw from the fact that although airlines were deregulated in the United States, neither the airports nor the air traffic management systems followed the same path which has led to serious distortions in the market. Treheway and Waters (1998) argue that neither the Civil Aeronautics Board nor price cap regulation would provide the stability that the political leadership is attempting to encourage. If the main aim of the politicians is to increase the levels of competition in an increasingly concentrated market, Dresner et al. (2002) suggest that the construction of new gates, alternative provisions that permit gate access to new entrants during peak periods, specifying minimum aircraft size provisions during peak periods and/or peak load pricing policies may be sufficient to increase competition in congested corridors. Winston (1993) argues that the use of reregulation to avoid "destructive" competition draws from the traditional but flawed theory of regulation which assumes that perfectly informed social welfare maximizers are either managing the regulation or running the regulated firms. It is argued that the airline industry appears to oscillate between periods of excessive concentration and destructive competition. The regulator needs to help the industry to find a happy medium in which neither extreme occurs. There is sufficient anecdotal evidence that airlines use hubs, gate access and frequent flyer programs as barriers to entrance, yet the hub-spoke system allows airlines to be cost efficient and serve markets that otherwise would not be served. Hubs are likely to continue for the foreseeable future because half the origin-destination traffic in the world is in markets too small to be served directly (Swan, 2007). However, as opposed to the discussions of excessive concentration being held in the United States Congress currently, Swan (2007) points out that the United States airline industry has not consolidated over the period of 1981 to 2001 according to the Herfindahl index, despite numerous mergers and bankruptcies. Winston (1993) argues that deregulation in multiple industries, including that of airlines, has proven to be positive for consumers, labor and producers, although not necessarily on an equal basis even within a group. Consequently, the question remaining for the regulator is how to protect the advantages of deregulation whilst maintaining reasonable levels of competition in city pair markets. Removing the remaining barriers to entry and exit, including the independent investment in gates and pricing of slots, will help further the impact so far achieved.

Finally, consumer protection rules need to be carefully balanced in order to ensure reasonable levels of service and behavior only where producers have been shown to be derelict. Examples of such laws include the three hour tarmac rule that passed through Congress in 2010. This rule has increased the likelihood of canceling flights due to the maximal $27,500 fine per passenger were the travelers to be forced to remain onboard the aircraft whilst waiting on the tarmac for longer than the legal limit. In 2009, the European Court of Justice ruled that passengers on flights delayed for more than three hours are entitled to compensation from airlines as is true for passengers on canceled flights. This begs the question as to whether these consumer rights in fact protect or harm passengers and whether there is a better way to handle congestion. We would argue that the issue of congestion and delay is better served through pricing appropriately rather than court cases or ad-hoc government restrictions imposed after a public outcry through the popular media.
5.2. Airport regulation

The aim of airport regulation is to ensure that airports do not abuse monopoly power, to incentivize airport managers to achieve productive efficiency and to provide the correct signals in the marketplace that would encourage appropriate utilization of the fixed facility. It would appear that all of these issues have yet to be resolved satisfactorily and will be discussed respectively. Niemeier (2002) argues that ex-ante regulation should be limited to activities with natural monopoly characteristics. Based on the premise that airports enjoy locational monopoly power, economic regulation has been undertaken in various forms ranging from cost based principles or rate of return regulation to incentive based structures. In Europe, prices are capped by the relevant civil aviation authority or Department of Transport, generally for a period of five years, after which a new review is undertaken. The price caps are frequently based on a value that changes according to inflation, for example the retail or consumer price index, less a pre-specified level of efficiency (RPI-X). An airport that achieves levels of efficiency greater than X will reap the cost reductions at least until the next review. Asymmetric information between the regulator and airport owners ensures that the review process is both time-consuming and relatively expensive but necessary where competition does not exist. Furthermore, privatized airports working under competitive conditions still may require regulation in order to prevent excessive pricing relative to their public counterparts serving under similar market conditions (Adler and Liebert, 2010).

An additional complication concerns the question of whether the regulation is based on a single or dual till computation because airports produce two revenue streams. On the aeronautical side airlines are charged per landing, based on maximum take-off weight, as well as a seat based fee. The non-aeronautical revenue stream draws from the terminal side in the form of concessions, car parking fees and rents from the development of airport land. Niemeier (2002) argues that single till regulation, which constrains overall airport profitability, may represent a first best solution for unconstrained airports provided non-aviation rents are sufficiently high. At the London airports price caps are set per airport and specify the upper level the airports may charge for their aeronautical services, restricted to only those activities associated with levels of congestion, this approach is clearly inappropriate (Jones et al., 1994). According to Averch and Johnson (1962), a company is prevented from fully exploiting monopoly power, there is a clear incentive to cross subsidize competitive offerings from those that are regulated. According to Kahn (1987) this is precisely what occurs at a single till, regulated airport and the solution is to sever the link between the revenues and costs associated with the airside from the revenues attainable on the commercial side. In the United States, airports are viewed as not-for-profit, public utilities and their pricing mechanism is based on cost recovery using a residual, compensatory or hybrid cost pricing approach. Consequently, this system does not require price regulation which appears to be advantageous. However, airports who do achieve profitability must then reinvest the revenues into the airport whether necessary or not. The residual cost approach that is more likely to arise at a hub in effect restricts airports to the equivalent of a single-till regulatory system which appears to be less appropriate for congested airports. Jones et al. (1994) argue that all airport services should be regulated because the airports enjoy monopoly presence in many markets including terminal side car parking services as well as airline related services. Reductions in the costs of services applicable to consumers directly, such as car parking, would stop the cross subsidization from commercial to airside activities and the consequent transfer of consumer surplus to the producers. Fu et al. (2011) argue that airports enjoy substantial market power due to low price elasticity on the aeronautical side which may be moderated by the vertical relationship between the airport and hubbing airline. In summation, dual-till regulation is preferable to the single till form at congested airports both in terms of encouraging productive efficiency and ensuring sufficient investment in infrastructure (Oum et al., 2004). Starkie (2008) argues that RPI-X price cap regulation encourages productive efficiency provided the airport acts as a profit maximizer rather than monopolist, however the same style of regulation also encourages excessive investment as defined in the Averch Johnson (1962) effect. Consequently, we would argue that dual till economic regulation is preferable with separate price caps on aviation and commercial services, restricted to only those activities over which airports enjoy monopolistic rents.

Another important issue for regulators concerns the need to ensure optimal capital investment in an industry with large fixed costs. The current pricing policies at airports do not provide the signals necessary to evaluate the need for capacity expansion or reduction. Barrett (2000) argues that there is no reason to assume that privatized airports are more likely to under-invest in infrastructure rather that this is more likely to occur under monopolistic regulatory conditions that restrict output below competitive levels, as indicated by the level of congestion that occurred under the traditional organization of airports prior to liberalization. However, Basso (2008) argues that social welfare maximizing public airports subject to a budget constraint are strictly preferable to unregulated profit maximizing private airports because the latter would overcharge for congestion leading to excessive traffic contractions. Martin and Socorro (2009) argue that a private, congested airport does not require price regulation provided the regulator ensures an appropriate capacity investment under which private and public objectives coincide. Cost plus regulation leads to over investment in either capacity or quality which leads to an unnecessarily expensive airport due to the spiraling regulated asset base cost issue. Since governments are frequently interested in stimulating economic activity, incentives may exist that encourage over investment (Forsyth, 2007). Whilst cost based regulation may lead to over investment, incentive based regulation may lead to under investment in which case the regulator then needs to consider an investment incentive mechanism as a counter balance.

Swelbar and Belobaba (2009) argue that the lack of infrastructure capacity at airports and air navigation service provision en-route are two of the most critical issues facing international and national air services today. Odoni (2009) argues that airport access is becoming the new form of market regulation that distorts the competitive outcome so sought after by many countries around the world. One of the major issues with regulation and optimal investment in airports lies in the mismatch between regulated price caps which are normally set every five years and the lifetime of an investment which may be closer to fifty. Privatized airports will be willing to invest only if they are reasonably sure that they will cover their investment costs. Carrier-served airports in the United States are defined as not-for-profits which allows them to receive infrastructure grants through the Airport Improvement Program but as the funds are drying up, taxes on passengers, i.e. the passenger facility charge added to airfares, and bond issues cover the remaining costs. Consequently, irrespective of airport ownership, the timing of capacity expansion will always be an issue unless the pricing policies change, permitting the market to signal the need for expansion through congestion and/or slot pricing mechanisms.
the first to remove such restrictions. There would appear to be ample evidence of the success of deregulation in the form of business model innovation and increased consumer surplus, hence the global policy emulation. However, the volatility of demand seriously impacts the airline industry, pushing the players between two extremes, excess concentration and destructive competition, which requires regulators worldwide to continue their vigilance. First, government oversight in the market should be restricted to the protection of competition rather than the protection of competitors such that no firm is too big to fail. Second, in order to protect the positive impact of airline deregulation, it is necessary to remove the remaining barriers to free entry and exit including bilateral agreements between nations, restrictive slot and gate allocations that grant preferred status to incumbent airlines and the foreign ownership restrictions and controls that prevent mergers across borders. In summation, the risks to society and possible solutions are summarized in Table 1.

Consequently, pricing congestion or scarcity, noise and emissions are far superior to the system of government restrictions that are currently applied to solve the bottlenecks in the aviation supply chain. Pricing provides the signals necessary to identify and subsequently search for solutions to constraints based on demand rather than ad-hoc short-term solutions. Specifically, one of the major limitations to the prosperity of air travel today is the ongoing regulatory regime that restricts and controls the airport and air traffic management capacities. Separation of powers is necessary in both arenas in order to prevent either elements from reregulating airlines. The airports, whether private corporations or public entities, need to be separated from political pressures defining slot or gate allocations and the civil aviation authorities, who set the air traffic management levels, need to be separated from the body that operates the system. Market distortions, limitations and inefficiencies will thus be removed. These strategies will enable the airlines, airframe and engine manufacturers and airports to better respond to demand and reduce the risks inherent in the existing system.

Acknowledgments

The authors would like to sincerely thank the organizers and participants of the Hamburg Aviation Conference of February 2010.
for fruitful discussions that led to the development of this paper. Nicole would also like to thank the Recanati Foundation for partial support of this work.

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