Observations and Potential Impacts of Regional Jet Operating Trends

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Abstract

Airlines are increasingly using regional jets to better match aircraft size to high value demand markets, and reduce labor costs. This has been especially important due to the increased pressure on the industry following September 11th 2001, because airlines see regional jets as a major part of their financial recovery plan. The increase in regional jets represents a significant change from traditional air traffic patterns and airline business models. To investigate the possible impacts of this change, this study analyzed the economic characteristics of regional jets, and well as the emerging flight patterns and performance of regional jets compared to traditional jets and turboprops.

It was found that regional airlines have lower crew costs per number of block hours and take offs, but higher crew cost per ASMs and RPMs. As a result, the revenues at regional airlines are more susceptible to changes in crew cost. It was also observed that regional jets operate differently then traditional jets. Regional jets increase the number of operations at airports and in the take off tracks around airports, which may result in increased congestion. Regional jets were also observed to exhibit lower climb rates than traditional jets, which may negatively impact air traffic control handling and sector design. Given the possible economic and operational problems associated with regional jets, their growth may pose unanticipated problems.

Introduction

One of the significant emerging changes to the national air space system is the number of regional jets, which has been increasing at an exponential rate. This rapid emergence of regional jets can be seen in Figure 1, which shows FAA registration data plotted between the third quarter of 1993 and the third quarter of 2002, for some of the regional jets commonly flown in the United States. The figure shows that the growth in regional jets is exponential, with CRJ2 and E145 registration data increasing the fastest. Airlines are moving to regional jet operations for two reasons. First because the smaller aircraft size allows them to better match the aircraft to the market, and second because of the reduced labor costs.

Regional jets have much lower crew costs then traditional jets and as result airlines are using them to reduce their overall costs. However, this cost structure is highly sensitive to changes that could potentially make regional jets as expensive as traditional jets. In addition, regional jets are used in much the same way as some traditional jets. As a result, the two jet types have a high level of interaction during climb and cruise. This interaction could cause new constraints on the national airspace system, which may in turn increase congestion and delays. This paper analyzes the possible economic and operational consequence of drastic regional jet growth.

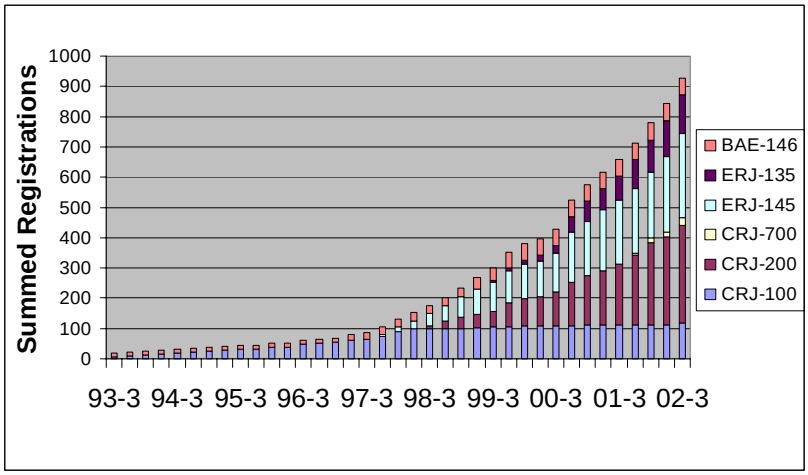

Figure 1: Regional Jet Registration Data

Methodology

In order to understand the financial impacts of regional jets, Form 41 data for the second quarter of 2002 was used. The data was grouped by carrier and by plane type to understand the cost differences between regional and traditional airlines.

In order to visualize the emerging trends in the air traffic system, flight data from the Aircraft Situational Display to Industry (ASDI) feed was used. This data is compiled by the Volpe center from the FAA's Enhanced Traffic Management System (ETMS). This study used data for all aircraft that had a take off time between midnight December 19th, 2002 GMT and midnight December 20th, 2002 GMT. While only one day of data is presented here, data starting in April 2002 has been analyzed and showed similar results. This set of data was broken down into four categories based on plane type: the narrow body traditional jets, the wide body traditional jets, the turboprops, and the regional jets.

Regional Jet Overview

Currently there are over 800 regional jets flying in the United States, with more than that number on firm order [1]. These planes range in size from about 30 to 70 seats, with a new 90

seat aircraft to be introduced this year. The planes are owned by both the major US airlines and by regional airlines. The major airlines tend to include regional jet operations as a separate spin off carrier, for example American Eagle for American airlines, or by code sharing with regional airlines. Table 1 shows the aircraft used by each airline as well as the code shares between regional and traditional airlines, as of February 2003 [2]. It is interesting to point out that a regional airline may have code shares with two competing major airlines, as is the case with Atlantic Coast Airlines, which code shares with both Delta and United [1].

Table 1: Regional Airlines and their Code Share Partners

Aircraft Type	Regional Carrier	Code Share Carrier
E135	American Eagle Continental Express Republic	American Continental America West, Delta, USAirways
E145	American Eagle Continental Express Mesa Republic Trans State	American Continental America West, Frontier, USAirways America West, Delta, USAirways American, US Airways
CRJ1	Comair Sky West	Delta Delta, United
CRJ2	Air Wisconsin Atlantic Southeast Mesa Sky West	Air Tran, United Delta America West, Frontier, USAirways Delta, United
CRJ7	American Eagle Atlantic Southeast Comair Horizon Mesa	American Delta Delta Alaska, Northwest America West, Frontier, USAirways
BA46	Air Wisconsin	Air Tran, United

The Case for Regional Jets

Airlines originally began purchasing regional jets to replace turboprops, which were not liked by passengers. However, as more regional jets entered the system, airlines began seeing other advantages and using them more. The smaller plane size allows the airlines to better and easier match the size of the plane to the size of the market. It also allows airlines to serve small communities that were too far to reach with a turboprop. The regional jet also allows for a more flexible use of the fleet because they perform almost like a traditional jet, but are closer in size to a turboprop. However, the most beneficial factor of using regional jets is the reduced cost of labor. Currently it is much cheaper for an airline to fly a regional jet instead of a traditional jet because crew, and especially pilot, costs are significantly lower. Figure 2 shows the crew costs per block hours for a few regional and traditional jets, as of the first quarter 2001 [3]. It can be seen that the regional jets have lower costs than the traditional jets.

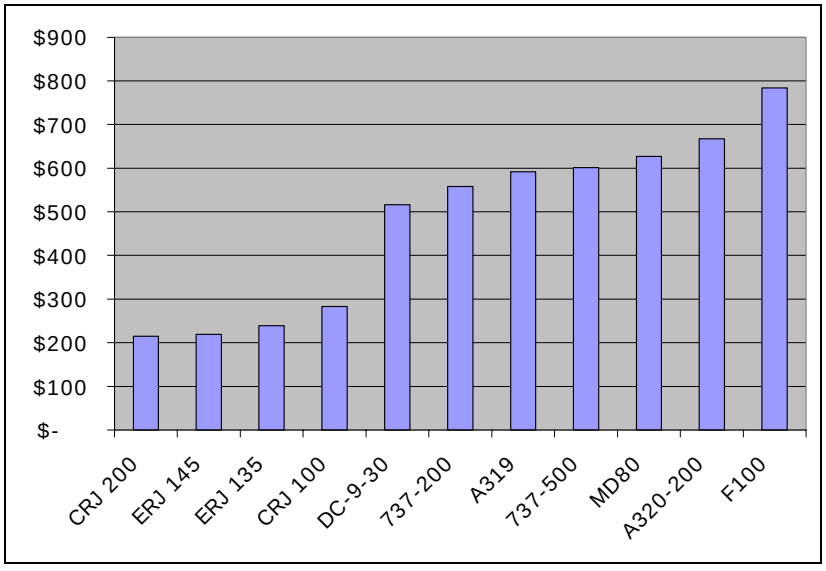

Figure 2: Aircraft Crew Costs per Block hours for 1Q 2001

Growth of Regional Jets

The growth of regional jet networks is shown in Figures 3, 4, and 5. These figures show the scheduled regional jet flights in 1998, 2000, and 2002 respectively. The data was obtained from the OAG and a straight line was drawn between the origin and destination creating a network map. It is clear from the figures that the number of regional jet flights increases with time, and that most of the growth occurs in the north-eastern part of the United States. The plots also show that the regional jet flights are structured around hubs.

Figure 3: Regional Jet Network Map in 1998 (Plot Courtesy of Ryan Tam)

Figure 4: Regional Jet Network Map in 2000 (Plot Courtesy of Ryan Tam)

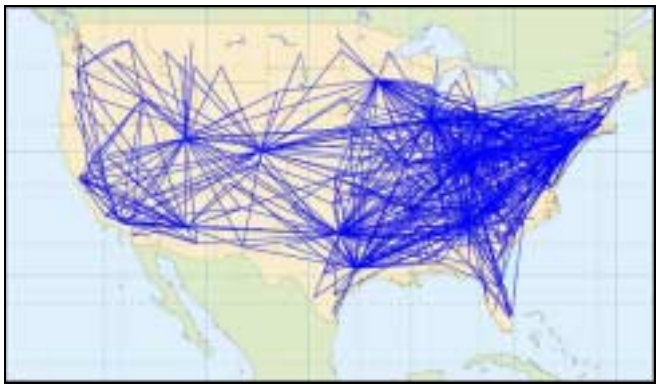

Figure 5: Regional Jet Network Map in 2002 (Plot Courtesy of Ryan Tam)

Scope Clause Restrictions

While the rapid growth of regional jets is what airlines want, it is not what pilots want. Pilots at major airlines feel threatened by regional jet pilots who work for less. They stand to lose either their job or their salary. As a result, pilots at major airlines have been fighting back with scope clauses. Scope clauses result from labor contracts made with airline pilots; they limit the number and size of regional jets that an airline can own and fly. Given that many airlines have been facing serious financial problems since 9/11/2001, many have been trying to renegotiate their existing pilot contracts to limit the effect of scope clauses. Currently, only USAirways and United have reached agreements, and both leveraged bankruptcy during the negotiations. However, if the economy does not recover rapidly other carriers may face bankruptcy and force their pilots to agree to more lenient scope clause restrictions, which would make the regional jet growth even more rapid.

Possible Consequences of Regional Jet Growth

Currently airlines seem to see only benefits in using regional jets. They are more flexible, liked by passengers, and most importantly cheaper. Airlines are using them as a major part of the strategy to recover from the post 9/11 crisis. However, there are two main issues that may

make regional jets a less than ideal solution. The first problem is that the planes are cheaper only because of the current labor cost structure. If that structure changes, and it looks at though it may, the cheapest planes may very quickly become the most expensive. The second problem is that regional jets perform differently then traditional jets and turboprops. While these differences add flexibility, they may also cause higher delays.

Consequences due to Regional Jet Economics

It has already been mentioned that regional jets have lower crew costs than traditional jets. Figure 6 shows the crew costs per block hours and per number of take offs for a group of regional and traditional airlines, during the second quarter of 2002. It can be seen that the regional airlines have the smallest costs per Block hour and per number of take offs. This is even more impressive when we take into account that they have fewer block hours and fewer take offs then the majors, because they fly few planes and shorter routes. The differences in flight lengths can be inferred from the distance between the two bars on the plot, the larger the distance the longer the flights.

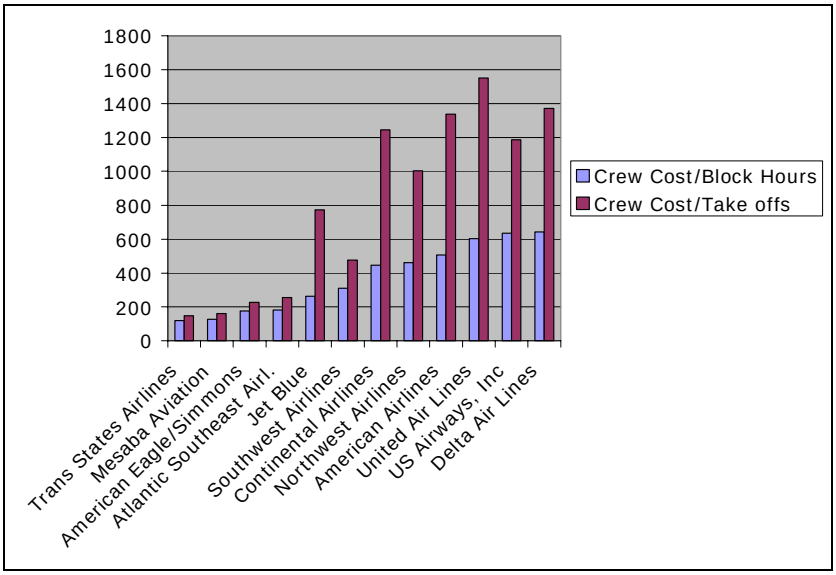

Figure 6: Crew Costs per Block Hour and Number of Takeoffs for 2Q 2002

Although the regional airlines have lower costs when measured relative to how much they fly, they have much higher costs measured relative to RPMs and ASMs. Figure 7 shows crew cost per ASMs and RPMs, and it can be seen that the regional airlines have higher costs then the traditional airlines. This is because the regional airlines fly fewer miles and have fewer seats because they have fewer and smaller aircraft. The difference between the two columns also gives an insight into the load factor, the larger the gap the lower the load factor. It can be seen that not only do the regional jets have fewer seats, they also have lower load factors, indicating that although they have fewer seats they are still not filling them as well as the major airlines. In addition to carrying fewer passengers, regional airlines also tend to charge lower average ticket prices. As result, it is harder for them to make up the costs of empty seats.

Despite the fact that regional airlines have low crew costs, their costs per ASMs and RPMs are high. This means that regional airlines have higher costs per passenger, and since they also have a smaller overall number of available seats, their revenue making potential is smaller. As a result, the bottom line of regional airlines is more sensitive to cost than that of the majors.

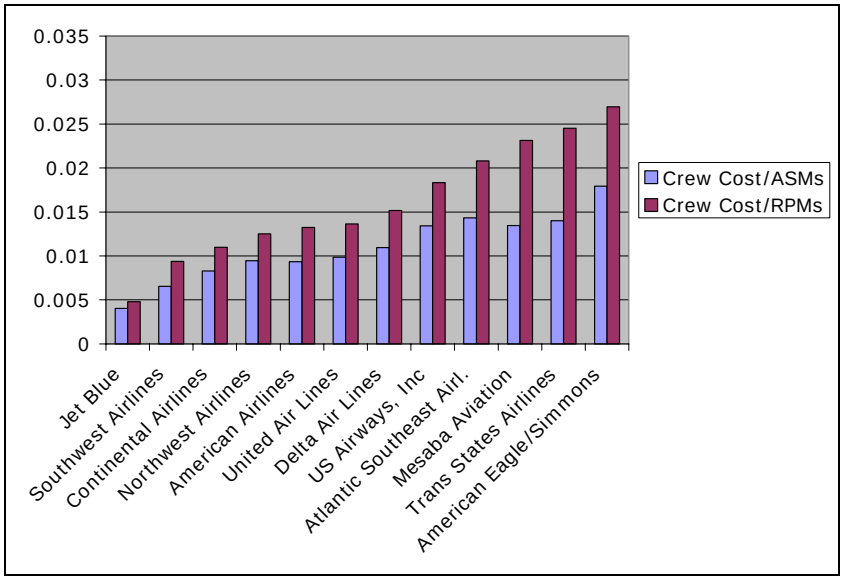

Figure 7: Crew Costs per ASMs and RPMs for 2Q 2002

Given that the regional airlines are more sensitive to changes in cost, it is necessary to examine the likelihood of the costs changing. There is no direct answer to this question. However it is known that the major pilots don't want their salaries to decrease, and that the regional pilots want to make more money. Currently, the economy is in a downturn and the major airlines are suffering. As a result, now is not a good time to fight for higher pay because a low paying job is still better then no job. However, when the economy recovers and capacity picks up, both the regional and major airlines will need new pilots, and the regional airlines will have to provide incentives for pilots to stay and not move up to the majors. In addition, many of the major airlines may have to credit their regional carriers for their contribution in keeping the airline from bankruptcy. This will give the regional pilots a bargaining chip that they can use to get higher salaries.

The pilots at one regional airline have already demanded higher pay. Comair is a wholly owned subsidiary of Delta, and on March 26, 2001 the pilots went on strike. They were asking for higher pay and benefits, but Delta stood firm and as a result the strike lasted until July 2, 2001 and cost Delta and estimated $2,000,000 a day [4]. In the end Delta agreed to raise salaries and grant partial benefits. The first year pay was raised from $16,000 to about $20,000 and pay for senior captains increased from about $66,000 to $85,000. While these new salaries are still much lower then those at major airlines they constitute a 25% increase in one case and 29% in the other, which is quite large [5].

Consequences due to Regional Jet Operations and Performance

The main issues resulting from an increase in regional jet operations will be focused on congestion problems. Regional jets typically need to use the same runways as traditional jets,

whereas turboprops often use shorter ones. As the number of regional jets increases, they will be competing for runway space, and eventually will cause delays and congestion at airports, because an increase in regional jet flights means that the number of operations per person will increase.

In addition to the runways, the tracks the planes fly on following take off may become congested as a result of increased operations. Figure 8 shows the flight tracks for planes leaving DFW on the 6th of February 2003 between midnight and 5 am GMT time. The black lines are the turboprops, and the light lines are regional and traditional jets. It can be seen that regional and traditional jets align on the same tracks, while turboprops fly on separate routes from all the other plane types. Since there are no regional jets sharing the turboprop routes this means that even regional jets that replace turboprops share routes with traditional jets. As a result, even turboprop replacement flights will result in increased congestion.

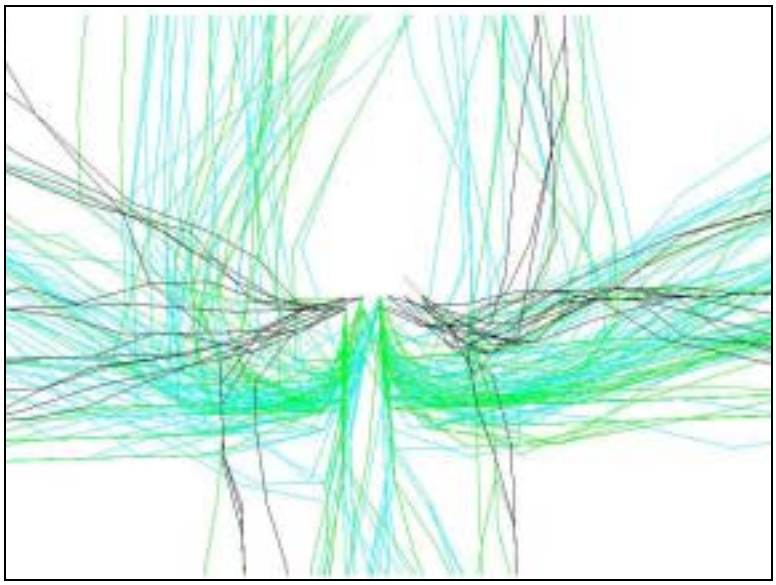

Figure 8: Flight Tracks for Planes Leaving DFW

Figure 9 shows the distribution of flight delays at DFW for the day of February 6th 2003. The plot is normalized so the comparison between aircraft categories is not distorted by the total

number of planes in that category. However, for reference there were 674 traditional jets, 253 regional jets, and 145 turboprops. The plot shows that traditional jet flights tend to have short delays with an average of 20 minutes, while turboprops and regional jets tend to have longer delays, but also have a wider range. The turboprop average delay was 23 minutes and the regional jet average delay was 33 minutes. The traditional jets most likely have the smallest delay because the controllers and airlines see them as the priority and schedule accordingly. The turboprops are most likely next because although they affect the traditional jets on take off, they turn away shortly after and follow a separate track. The regional jets pay the highest penalty in terms of delay because they compete with traditional jets for runway resources and interact with them after take off. The regional jets are kept waiting on the ground so that the traditional jets can have smaller delays.

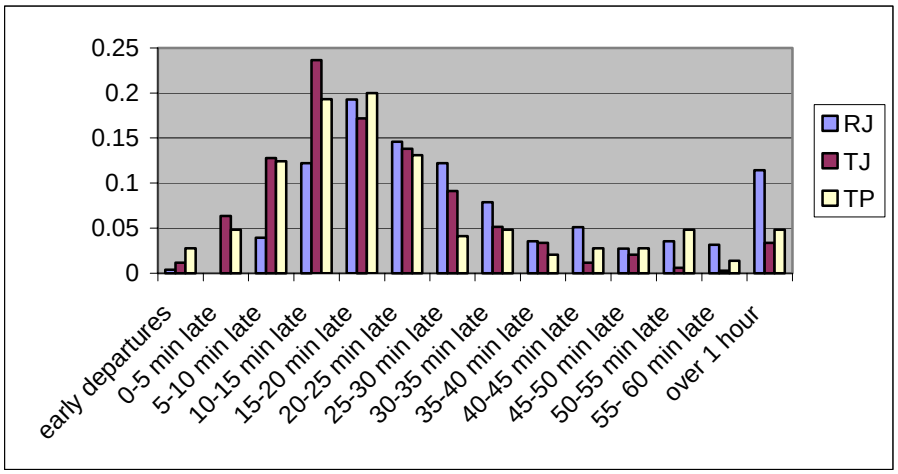

Figure 9: DFW Normalized Delay Histogram

In addition to congestion issues due to an increase in operations, congestion and delay problems may also appear due climb performance differences between regional and traditional jets. Figure 10 shows the altitude vs. time plot for flights between CLE and ORD. It can be seen from the plot that both the CRJ and ERJ climb slower then the Boeing or Airbus planes. The

ERJ in particular stands out as having a slower climb rate. This data represents only one data point; however, a number of examples exhibit the same behavior.

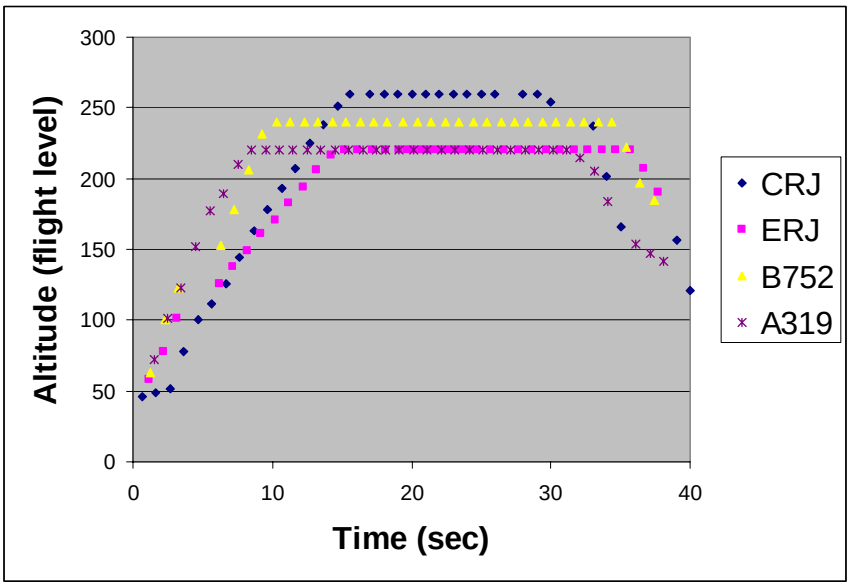

Figure 10: Altitude vs. Time for Flights from CLE to ORD

The slower climb rate of regional jets increases the range of aircraft performance that controllers must understand and anticipate in order to adhere to proper separation standards. A slower climb rate will potentially change how regional jets interact with the sector structure. Many of the irregular sector shapes found in the current air traffic management system are a direct consequences of modifications targeted at reducing the number of sector boundary crossings. Boundary crossings are avoided because each transition results in increased radio communications and coordination workload. Figure 11 shows a close up of Figure 10 with hypothetical sector boundaries imposed on top. It can be seen from the figure how the slower climb performance of regional jets may increase the number of sector boundary crossings. Sector boundaries have evolved such that a traditional jet could be handed off directly from one sector to another. However, the slower climb rate of the regional jets may cause them to miss the

transition as can be seen in the circled part of the plot. In this case both the regional jets require an additional transition before they reach the same sector as the traditional jets. To fix this problem sector could be restructured to better support the range in aircraft performance. The dotted line on the figure shows the new sector boundary.

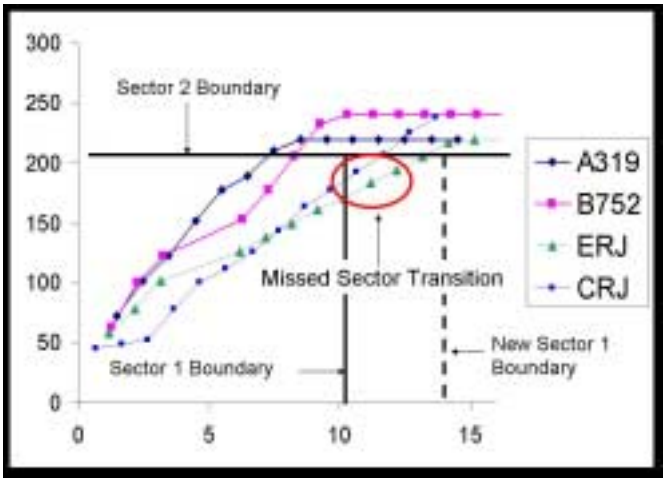

Figure 11: Effect of Climb Rates on Sector Structure

The problems presented above are based on data during a time of reduced capacity. When the economy recovers, and when all the regional jets on firm order are delivered, the number of planes in the national airspace system will drastically increase, and all the problems presented above will be magnified. Even if the cost structure of regional jets does not change, and they remain a cheaper alternative to other planes, the cost of delays and passenger dissatisfaction may make the lower labor costs less attractive.

Conclusion

Airlines are increasingly using regional jets to better match aircraft size to high value demand markets, and reduce labor costs. This has been especially important due to the increased pressure on the industry following September 11th 2001, because airlines see regional jets as a major part of their financial recovery plan. The increase in regional jets represents a significant

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