Regional Jet Aircraft Competitiveness: Challenges and Opportunities

Tamilla Curtis
Embry-Riddle Aeronautical University, curtist@erau.edu

Dawna L. Rhoades
Embry-Riddle Aeronautical University, rhoadesd@erau.edu

Blaise P. Waguespack Jr.
Embry-Riddle Aeronautical University

Scholarly Commons Citation
Curtis, T., Rhoades, D. L., & Waguespack, B. P. (2013). Regional Jet Aircraft Competitiveness: Challenges and Opportunities. *World Review of Entrepreneurship, Management and Sustainable Development, 9*(3). https://doi.org/10.1504/WREMSD.2013.054736

Regional jet aircraft competitiveness: challenges and opportunities

Tamilla Curtis*, Dawna L. Rhoades and Blaise P. Waguespack Jr.

College of Business,
Embry-Riddle Aeronautical University,
Daytona Beach, FL, USA
E-mail: curtist@erau.edu
E-mail: Dawna.Rhoades@erau.edu
E-mail: Blaise.Waguespack@erau.edu
*Corresponding author

Abstract: The regional jet aircraft is a unique market niche. Particularly suitable for providing capacity in the 30 to 90 seat range, these jets are often used to connect smaller airports to network carrier hubs, as well as to fill in during slow periods. The market is currently dominated by two manufacturers: Brazil's Embraer and Canada's Bombardier. Due to the nature of the global aircraft industry, Embraer and Bombardier are largely dependent on the international sale of their aircraft for steady revenue streams. Orders and deliveries of aircraft with fewer than 100 seats have grown rapidly over the past ten years. The study provides an overview of the aviation industry, particularly in the regional jet (RJ) sector, and examines country-specific factors affecting the number CRJ and ERJ deliveries. Results of stepwise regression indicate that a two-year lag of GDP, a two-year lag price of crude oil, a two-year lag of prior aircraft deliveries, and the country-specific land areas account for almost 40% of the variance in the aircraft deliveries. However, there are many additional factors which have an effect on RJs orders and deliveries.

Keywords: regional jet; aviation; aircraft deliveries, management; strategy.

Biographical notes: Tamilla Curtis is an Assistant Professor of Management at Embry-Riddle Aeronautical University, FL, USA. She holds a Doctor of Business Administration from Nova Southeastern University, an MBA in Aviation from Embry-Riddle Aeronautical University, and BS in Electrical Engineering from Gubkin Russian State University of Oil and Gas in Moscow. Her Russian background and extensive international work experience, including Russia, South-Africa, the UK, and the USA, contribute to her research interests involving strategic management and international business.

Dawna L. Rhoades is an Associate Dean and Professor of Management in the College of Business at Embry-Riddle Aeronautical University in Daytona Beach, Florida. She currently teaches international business, strategic management, international aviation management, and social responsibility and ethics. She received her PhD from the University of Houston. Her current research interests include strategic alliances, safety and quality issues at airlines

and airports, corporate governance, and issues relating to intermodal transportation. Her work has appeared in numerous journals including *Managing Service Quality*, *Journal of Air Transport Management*, *Journal of Transportation Management*, *Journal of Air Transport World Wide*, *Journal of Managerial Issues*, and *International Journal of Organizational Analysis*. She is the author of the Ashgate Publishing book *Evolution of International Aviation: Phoenix Rising*.

Blaise P. Waguespack Jr. graduated from the University of North Texas with a PhD in Marketing and is a Professor of Marketing in the College of Business at Embry Riddle Aeronautical University in Daytona Beach, Florida. He co-authored a chapter in *Handbook of Airline Strategy* and has publications appearing in journals such as the *Journal of Marketing Theory and Practice*, *Managing Service Quality*, *Journal of Transportation Management*, *Journal of Air Transportation World Wide*, *Journal of Air Transport Management* and other international and national conference proceedings. Aviation industry firms he has worked with include Bombardier Aerospace, UAL, Continental, TWA, Allied Signal, and American Express. His research interests are in the areas of service marketing, airline service quality and airport services.

1   Introduction

The worldwide demand for air travel is largely driven by economic growth, and the air transport industry is currently recovering from the recent economic recession. Each regional market represents many unique characteristics. Aircraft demand in North America and Europe is driven primary by the need to replace aging airplanes and mostly concentrates on single-aisle jetliners [Boeing, (2011), p.14]. In contrast, Asia Pacific and the Middle East regions are more focused on twin-aisle airplanes.

The commercial aviation fleet consists of large passenger jets with over 100-seating capacity, regional jet (RJ) aircraft with up to 100-seats capacity, and smaller turboprop aircraft. In the USA, regional aircraft provide connecting services for passengers to larger carriers. Airlines are looking for new ways to lower operating costs by utilising more fuel efficient aircraft, eliminating unprofitable routes, and implementing other cost saving measures (FAA, 2011). The US Federal Aviation Administration (FAA) forecasts that one billion passengers will be flown in 2021, two years earlier than was projected before (FAA, 2011). This will contribute to the increase in demand for regional carriers, and as result, an increase in RJ orders and deliveries.

The purpose of this study is to investigate the current trends in the aviation industry in regards to RJ deliveries, and examine several factors on a country-level that can potentially explain Embraer and Bombardier aircraft deliveries, such as GDP, price of crude oil, prior aircraft deliveries and the land area of receiving RJ countries.

2   Global trends

The aerospace industry is very cyclical in its nature. The industry-specific cycle seems to occur approximately every ten years and is highly influenced by a variety of market forces. Commercial aircraft manufacturing sales are directly tied to the demand in the air

travel, which is affected by a country's economic state and activities as well as regional conflicts and disease outbreaks (Platzer, 2009). The global economy is one of the powerful drivers of growth in commercial aviation and new aircraft orders [Boeing, (2011), p.6]. Economic growth stimulates an air transportation growth, and in turn, an increase in air transportation leads to the economic growth [Boeing, (2011), p.8]. Growth in air travel, measured in revenue passenger-kilometres (RPK), historically outpaced economic growth, represented by GDP, by approximately 1.5 to 2% [Boeing, (2011), p.8]. On average, air travel revenues total to approximately 1% of GDP regardless of the size of the national economy. The other 20-40% air travel growth can be attributed to the convenience and speed of air travel including arrival and departure times, flight routes, choice of carriers, as well as fares and classes [Boeing, (2011), p.8]. Government regulations can also boost an increase in air traffic demand such as openness of country's bilateral air services.

After the 2009 recession, the worldwide economy started to expand. In 2010 the advanced economies had 1.8–2.9% growth in output and the emerging markets grew at 6.6%. China is predicted to become the world's second largest economy by 2014 [FAA, (2011), p.32]. According to Boeing's Current Market Outlook, from 2010 to 2030 the world economy is expected to grow by 3.3%, airplane fleet by 3.6%, number of passengers by 4.2%, and RPK, which is an indicator of airline traffic, by 5.1% [Boeing, (2011), p.4]. This will result in nearly doubling of aircraft from around 19,400 airplanes currently in service to more than 39,500 airplanes in 2030, totalling to approximately US$4.0 trillion [Boeing, (2011), p.6]. Forty percent of the projected new airplane orders will come from the need to replace older and less efficient airplanes to meet the rising fuel costs.

Single-aisle aircraft, which are utilised in the short-to medium-haul market, represent 62% of today's world fleet and forecasted to more than double by 2030, reaching 27,750 airplanes or 70% of the total world fleet [Boeing, (2011), p.9]. This trend can be explained by the expansion of air travel in Asia and emerging economies and the growth of the low-cost carrier model. However, twin-aisle airplanes projected to be the fastest growing segment with the average annual rate of 4.4%. This segment forecasted to grow from 3,640 airplanes to 8,570 airplanes in 2030 [Boeing, (2011), p.9]. The large aircraft fleet is expected to have modest growth from about 770 currently in operations to 1,140 in 2030. The majority of the demand in this sector will come from the freighter market.

3 RJ market

According to Wong et al. (2005) there is no universally accepted definition of a RJ. It is widely acknowledged that a 'RJ' is an aircraft put in service since 1992 and has under a 100-seat capacity. However, this definition has been challenged as large RJs such as Embraer E190 and E195, and the Bombardier CS100/300 with the capacity of up to 130 passengers shares many similarities with the smallest products offered by Airbus and Boeing [Aerospace Global Report, (2011), p.7]. Airbus and Boeing aircraft generally are not considered to be RJs.

When the first RJs were introduced by Bombardier in 1992, the forecast for these types of aircrafts were very pessimistic [Wong et al., (2005), p.152]. In 1993 Comair offered the first RJ service in the US market. Despite the forecast, RJs made a significant contribution to the US air transport over the last decade [Wong et al., (2005), p.161], as

well as to the worldwide air travel (see Figure 1). Most of the RJ services resulted from airlines' hub and spoke cities. In the US, RJs serve either new markets which were previously beyond reach by turboprops, or current markets by replacing mainline carriers on routes with fewer passengers in order to increase profitability by lowering operating expenses.

Figure 1   RJ deliveries

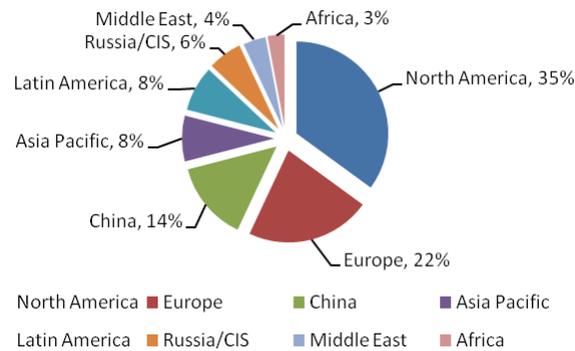*Source:*   Adapted from Aerospace Global Report (2011)

The forecasted demand in the RJ segment will come from the 60–120 seat aircraft category. This category offers greater passenger capacity and lower operating costs per available seat mile. Although 20–59 seat aircraft remain the largest fleet area within the RJ segment at the present time, the demand for these planes will slowly diminish. "Embraer and Bombardier have offerings in 100+ seat category, which has traditionally been dominated by Boeing and Airbus. Embraer E jets series, comprising E170/175/190/195, can carry up to 120 passengers. Similarly, the Bombardier C series, comprising CS100/300, can ferry up to 130 passengers" [Aerospace Global Report, (2011), p.7]. Embraer and Bombardier forecast significant growth in sales during the next 20 years. They are planning to meet higher demand and to replace existing older aircraft (Done, 2011). Embraer forecasts a requirement for 6,875 new jets in the 30 to 120-seat segment during the next 20 years with a total market value estimated about $200 billion US. About 3,980 jets will be delivered in the second half of the period between 2020 and 2029, and of the total 3,885, will be accounted for by the larger aircraft in the 90 to 120-seat segment (Done, 2011).

In 2010, The FAA reported that the US commercial aircraft fleet consisted of 7,096 aircraft including 3,713 mainline large passenger aircraft with over 90 seats, 2,577 regional carriers (jets, turboprops, and pistons), and 806 cargo aircraft [FAA, (2011), p.23]. Regional carriers represent more than 36% of the total US commercial air carriers or 41% of the passenger aircraft fleet. Also in 2010, domestic and international passenger growth for US regional went up 0.5%, while mainline carriers went up only 0.1% [FAA, (2011), p.16]. By 2031, the US commercial aircraft fleet is forecasted to increase to 10,523 at 1.9% or 163 aircraft annually while the RJs with 90 or fewer seat are projected

to grow at an average annual rate of 2% or from 1,771 in 2010 to 2,764 in 2031 [FAA, (2011), p.43].

FAA forecasts indicated that while demand for 70–90 seat aircraft will continue to increase, the demand for 50-seat regional aircraft is predicted to fall. As an example, in 2010 US regional carriers increased their fleet of 70–90 seat jet aircraft and reduced their fleet of 50-seat aircraft. RJs allow carriers to fly longer routes which were not previously accessible with turboprop aircraft, and at a lower cost. The current trend is narrowing the gap between the size and aircraft types operated by the mainline and regional operators. Traditionally, the US has been the largest market for RJ deliveries. North America holds the dominant position with an expected 35% share of new deliveries (see Figure 2). However, "Europe/Russia with 28 percent share and China with 14 percent are expected to be the next big markets in terms of deliveries of regional jets" [Aerospace Global Report, (2011), p.7].

Figure 2 RJ demand by geographic area, 2010–2029 (total 6,875 units) (see online version for colours)

Source: Adapted from Aerospace Global Report (2011)

According to Aerospace Global Report (2011) regional market demand between 2011 and 2030 forecasts as following: Asia Pacific 11,450 new airplanes valued at $1.510 billion US, Europe 7,550 new airplane at $880 billion US, North America 7,530 new airplanes at $760 billion US, Latin America 2,570 new airplanes at $250 billion US, Middle East 2,520 new airplanes at $450 billion US, Commonwealth of Independent States 1,080 airplanes at $110 billion US and Africa 800 new airplanes at $100 billion US.

4 RJ aircraft manufacturers

Embraer is a Brazilian conglomerate for the commercial airline market, business aviation market, defence market, and a provider of aviation services. The company was founded in 1969 by a military group with the Brazilian government holding a 51% of the voting shares [Espana, (2004), p.489]. Embraer products include commercial, military and corporate aircraft with commercial planes accounting for more than half of the company's total sales revenue [Espana, (2004), p.489].

Beginning its commercial RJ manufacturing in 1996, Embraer first entered the US market in 1997 with its 50-seat ERJ-145 and ERJ-135 in 1999 [GAO, (2001), p.40). Table 4 in the Appendix presents a list of 48 countries with ERJ deliveries. According to the Embraer forecasts, one of the faster growing segments will be the Chinese regional aviation market. Embraer forecasts a demand for 975 RJs (15 of 30–60 seats, 440 of 61–90 seats and 520 of 91–120 seats) for 2011-2030 period accounting for 13% of global market (Karp, 2011). As a result, Embraer acquired China Southern Airlines and Hebei Airlines as new customers.

Bombardier Aerospace is a division of Canadian conglomerate Bombardier Inc., one of the leading aircraft manufacturers in the world. Bombardier Inc. is a manufacturer of transportation equipment and a provider of related services, including business and commercial aircraft as well as rail transportation equipment and systems. The company operates in two segments: aerospace (through BA) and rail transportation (through BT). BA designs and manufactures aviation products and providing related services. BA's aircraft portfolio includes a series of business and commercial aircraft such as RJs, turboprops, and single-aisle mainline jets as well as amphibious aircraft. BT designs and manufactures rail equipment and systems along with offering associated services.

Bombardier's commercial aircraft consist of three families: the CSeries aircraft, the CRJ NextGen aircraft, and the Q400 NextGen aircraft. Bombardier was the first to enter the US market in 1993 with Canadair Regional Jet (CRJ) in the 50-seat capacity [GAO, (2001), p.40]. A list of the 36 countries with CRJs delivered is presented in the Appendix Table 5. The CSeries is a new jet in the 100–149 seat class, which is scheduled to enter into service in 2013. The Q400 NextGen aircraft is a turboprop driven aircraft. Over the next 20 years, Bombardier forecasts demand for 13,100 aircraft in the 20–149 seat market, which will generate approximately $639 billion US in total sales. The 20–99 seat categories will account for 34% while the 100–149 seat segments will account for 66% [Bombardier, (2011), p.5].

Emerging manufacturers in Japan, China, and Russia are planning to compete with the established producers in the main segments of the global commercial aerospace industry. Government plays an important role in supporting their national manufacturers [Aboulafia, (2011), p.16]. For example, Bombardier is getting government aid for its CSeries and the Russian and Chinese manufacturers are all government-funded. Although new entrants offer lower manufacturing costs, some experts believe that because those companies are government owned, the firms will be able to fill a niche in the domestic market, but will be unable to compete on a global scale (Aboulafia, 2011).

New entrants include the Mitsubishi Aircraft Corporation, a subsidiary of Japanese Mitsubishi Heavy Industries which was established in 2008 to develop the Mitsubishi Regional Jet in a 70–90 seat capacity. Their interested customers include Japanese All Nippon Airways, American Trans Holdings, and a Hong Kong-based aircraft lease and maintenance company, ANI Group Holdings Ltd. (MRJ-Japan, 2011). Another prospective competitor is AVIC I Commercial Aircraft Company based in China; a consortium of six companies and aerospace research institutes, which was acquired by the Commercial Aircraft Corporation of China in 2009 (Aerospace-Technology, 2011). In the near future China's ARJ21 is also scheduled to enter service, followed by the Mitsubishi Regional Jet (Done, 2011).

The Sukhoi Super Jet 100 is a Russian RJ in the 75- to 95-seat category developed by the civil aircraft division of Russian aerospace company Sukhoi in cooperation with Western partners (Sukhoi, 2010). The first Superjet 100 started flying with Armavia on the route between Yerevan and Moscow in April, 2011. Another possible RJ competitor in the 70–100 seat capacity is the Indian RJ or the HAL/NAL Regional Transport Aircraft, which will be a future project of Hindustan Aeronautics Limited and National Aerospace Laboratories.

The single-aisle large jetliner is currently dominated by two manufacturers, Boeing with its 737 and Airbus with the A320. However, Embraer and Bombardier are trying to break into the mainline single-aisle market with its new 110–130 seat airplanes [Aboulafia, (2011), p.16]. With the increase in demand for air travel, two-thirds of the 100–149 seat segment are over 15 years old and over 50% of all single-aisle flights carry less than 150 passengers (Bombardier, 2011). A major gap exists in the 100–149 seat segment (Bombardier, 2011). Any new possible entrants in this segment include new aircraft development of China's Comac with its 150-seat C919, and Russia's United Aircraft with its 150–200 seat MS-21. Ryanair, the low cost Irish airline, is already considering a possibility to order either of those new jets (Aviation Week, 2011).

5 Research question and methodology

This paper has presented trends in RJ aviation market and has focused on main RJ manufacturers: Bombardier of Canada and Embraer of Brazil. Since the worldwide demand for air travel is linked to a number of economic factors, the purpose of this research is to investigate whether the factors of GDP, price of crude oil, country-specific land areas, and prior RJ deliveries, can be effective predictors for future RJ deliveries.

Official Airline Guide data between 1996 and 2011 was collected for RJ deliveries for the ERJ family in the 37–50 seating capacity, the ERJ family in 70–120 seating capacity, and the CRJ NextGen family RJ in the 60-99 seat segment. Country specific GDP historical data was obtained from the World Bank statistical resources. Historical price data for crude oil was collected from the Energy Information Administration of the US Department of Energy. West Texas Intermediate, listed as WTI Cushing Oklahoma, is the grade of crude oil that was used as a benchmark in oil pricing. Countries' land area was collected from the online world atlas.

A two-year lag was applied to the GDP and oil pricing to accurately measure the relation between economic indicators and aircraft deliveries. Additionally, a two-year lag was applied to test the relationship between previous and present aircraft deliveries.

Stepwise regression method was employed in order to answer which of the possible four predictor variables included (GDP two-year lag, crude oil two-year lag, land area and deliveries two-year lag) are relevant for predicting RJ deliveries. Does the obtained regression equation resulting from the four predictor variables present a reliable prediction of RJ deliveries?

Data screening led to the total of 414 observations for Embraer and Bombardier RJs deliveries (see Table 1).

Table 1   SPSS statistical output

Descriptive statistics			
	Mean	*Std. deviation*	*N*
Sum of deliveries	7.59	15.554	414
GDP	2.5827674992678E12	3.84810871584945E12	414
WTI crude oil	48.1059	26.12710	414
Land area km^2	3006853.12	3994641.585	414
Sum of deliveries two year lag	6.89	15.763	414

Correlations						
		Sum of deliveries	*Sum of deliveries two year lag*	*WTI crude oil*	*Land area km^2*	*GDP*
Pearson correlation	Sum of deliveries	1.000	.509	–.188	.463	.569
	Sum of deliveries two year lag	.509	1.000	–.170	.463	.584
	WTI crude oil	–.188	–.170	1.000	–.038	–.032
	Land area km^2	.463	.463	–.038	1.000	.630
	GDP	.569	.584	–.032	.630	1.000
Sig. (one-tailed)	Sum of deliveries	.	.000	.000	.000	.000
	Sum of deliveries two year lag	.000	.	.000	.000	.000
	WTI crude oil	.000	.000	.	.218	.256
	Land area km 2	.000	.000	.218	.	.000
	GDP	.000	.000	.256	.000	.
N	Sum of deliveries	414	414	414	414	414
	Sum of deliveries two year lag	414	414	414	414	414
	WTI crude oil	414	414	414	414	414
	Land area km 2	414	414	414	414	414
	GDP	414	414	414	414	414

Table 2   Model summary

Model	R	R square	Adjusted R square	Std. error of the estimate	Change Statistics				
					R square change	F change	df1	df2	Sig. F change
1	.569[a]	.324	.323	12.802	.324	197.673	1	412	.000
2	.609[b]	.371	.368	12.361	.047	30.905	1	411	.000
3	.623[c]	.389	.384	12.205	.017	11.548	1	410	.001
4	.632[d]	.399	.393	12.114	.011	7.218	1	409	.008

Notes: [a]Predictors: (constant), GDP
[b]Predictors: (constant), GDP, sum of deliveries two year lag
[c]Predictors: (constant), GDP, sum of deliveries two year lag, WTI crude oil
[d]Predictors: (constant), GDP, sum of deliveries two year lag, WTI crude oil, land area km^2

Table 3 Analysis of variance

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	32,396.260	1	32,396.260	197.673	.000[a]
	Residual	67,521.933	412	163.888		
	Total	99,918.193	413			
2	Regression	37,118.511	2	18,559.256	121.463	.000[b]
	Residual	62,799.682	411	152.797		
	Total	99,918.193	413			
3	Regression	38,838.829	3	12,946.276	86.903	.000[c]
	Residual	61,079.364	410	148.974		
	Total	99,918.193	413			
4	Regression	39,898.061	4	9,974.515	67.970	.000[d]
	Residual	60,020.132	409	146.748		
	Total	99,918.193	413			

Notes: [a]Predictors: (constant), GDP
[b]Predictors: (constant), GDP, sum of deliveries two year lag
[c]Predictors: (constant), GDP, sum of deliveries two year lag, WTI crude oil
[d]Predictors: (constant), GDP, sum of deliveries two year lag, WTI crude oil, land area km^2
[e]Dependent variable: sum of deliveries

Stepwise regression results indicate that when GDP was entered first (model 1), it accounted for 32% in the prediction in aircraft delivery, $R^2 = 0.324$, $R^2adj = 0.323$, $F(1,412) = 197.673$, $p < 0.001$. When additional three variables were entered, they improved model to account for almost 40% of variance in the aircraft deliverers, $R^2 = 0.399$, $R^2adj = 0.393$, $F(4,409) = 67.970$, $p < 0.001$ (see Table 2 and Table 3).

6 Discussion of the results

Economic growth is linked to the significant increase of personal consumption including demand in air travel. Approximately 60 to 80% of air travel growth can be attributed to economic growth (Boeing, 2011). Developed and emerging market economies have generated more than 70% of global GDP, which has directly influenced the air transport industry. Emerging markets are the driving force of world economic growth, while developed countries are growing at a much slower rate [Embraer, (2011), p.6]. The results of this study are in support of this trend. GDP accounts for 32% of the variation of worldwide RJ deliveries. In order to accommodate air travel demand, airlines are in need to expand their fleet by placing new orders of RJs.

Fuel prices directly affect aircraft operating cost and make up a significant portion of an airline's total costs. According to Airlines for America (formerly the Air Transportation Association of America), fuel is an airline's second largest expense. For the past decade, airlines' non-fuel costs have risen by 4.5% while fuel costs, as a percentage of revenue, rose from 14% in 2001 to 33.5% in 2008. These fuel cost increases parallel increases in crude oil prices from an average US$19 per barrel in the 1990s to US$114 per barrel in May 2011. "A forecast by the US Energy Information Administration indicates that the price of oil will average US$103 per barrel during the

20-year forecast period" (Aerospace Global Report, 2011). Rising aviation fuel prices influence airlines to replace older aircraft with new ones that are more fuel-efficient while also conform to stricter environmental requirements (Aerospace Global Report, 2011).The results of this study provide a support that a two-year lag in the crude oil pricing accounts for the RJ deliveries. However, this relationship is not straight forward. Although there is a negative correlation between an increase in oil prices and aircraft delivery, (r = –0.188), airlines might be in need for more fuel efficient newer models when the oil prices are going up.

Prior aircraft deliveries are linked to present aircraft deliveries (r = 0.59). A two-year lag was applied to the research model, which made an improvement in the regression model. By operating a fleet of RJs, airlines are more likely to order more this type of airplanes.

Although a country's land area is positively linked to the aircraft deliveries (r = 0.463), it does not improve the regression model by much. In the US, RJs are usually used in the hub and spoke system to feed larger carriers. RJs fly shorter routes than traditional jets, have faster turnaround times and higher frequency of service. Europe has different uses for RJs operation due to the extensive network of trains which can be used on the shorter trips. Perhaps the population 'clumpiness', which is the difference between the population densities in urban and rural areas, can be a better predictor for future aircraft deliveries.

7   Conclusions

This paper has explored trends in the RJ segment of the aviation industry by focusing on two main RJ manufacturers: Brazilian Embraer and Canadian Bombardier. Four indicators: GDP, crude oil pricing, countries' land area and prior aircraft deliveries, were investigated to identify whether those variables can predict future RJ deliveries. The evidence shows that those four variables account for almost 40% for variance in the RJs deliveries. However, there are many additional factors which have an effect in regards to RJs. For example, in the US one of the major obstacles for RJ orders is labour scope clauses, which limit the number of RJs that an airline can own and operate.

Although Embraer and Bombardier presently enjoy a duopoly in the RJ market, new entrants from emerging markets are coming to the global arena. While it will take time for the new producers to build a global presence, potentially this can present a threat to Embraer and Bombardier's well-established markets.

References

Aboulafia, R. (2011) 'Single-aisle jets: the more things change', *Aerospace America*, July/August, Vol. 2, No. 2, p.16.

Aerospace Global Report (2011) *A Clearwater Industrials Team Report*, Clearwater Corporate Finance, LLP, available at http://www.imap.com/imap/media/resources/Aerospace_8_1FED752787A1E.pdf (accessed on 8 February 2012).

Aerospace-Technology (2011) *ARJ21 Regional Jet Aircraft, China, China*, Aerospace-technology.com, available at http://www.aerospace-technology.com/projects/arj21/ (accessed on 3 March 2012).

Aviation Solutions Fleet Database (2011) 'Backlog by manufacturer', *Official Airline Guide*.

Boeing (2011) *Current Market Outlook*, available at http://www.boeing.com/commercial/cmo/methodology.html (accessed on 20 January 2012).

Bombardier (2011) *Commercial Aircraft Market Forecast, 2011–2030*, available at http://www.bombardier.com/files/en/supporting_docs/BA-BBA_2011_Market_Forecast.pdf (accessed on 11 May 2012).

Done, K. (2011) 'Regional jets: Emerging producers shake up the old order', *Financial Times*, available at http://www.ft.com/cms/s/0/7bdc56ce-988f-11e0-94d7-00144feab49a.html#axzz1nV1s3YZV (accessed on 11 May 2012).

Embraer (2011) *Embraer China Market Outlook, 2011–2030*, available at http://www.embraer.com/Multimdia/China_Market_Outlook_English.pdf (accessed on 11 May 2012).

Espana, J. (2004) 'Explaining Embraer's hi-tech success: porter's diamond, new trade theory, or the market at work?', *Journal of American Academy of Business*, Vol. 4, pp.489–495, Cambridge.

FAA (2011) *FAA Aerospace Forecast, Fiscal Years 2012–2032*, Federal Aviation Administration, available at http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/ (accessed on 11 May 2012).

Flottau, J. (2011) 'Ryanair Considering C919s, MS-21s for Fleet', *Aviation Daily*, March, Vol. 383, No. 39, p.1.

GAO (2001) *Aviation Competition: Regional Jet Service Yet to Reach Many Small Communities*, Report to the United States Senate, United States General Accounting Office, available at http://www.gao.gov/new.items/d01344.pdf (accessed on 10 January 2012).

Karp, A. (2011) *Embraer: 975 30-120 Seat Jets to be Delivered to China Over 20 Year, Air Transport World*, 22 September, available at http://atwonline.com/aircraft-engines-components/news/embraer-975-30-120-seat-jets-be-delivered-china-over-20-years-0921 (accessed on 14 May 2012).

MRJ-Japan (2011) *ANI Group Holdings Ltd. Sings MOU with Mitsubishi Aircraft for Purchase of 5 MRJ Aircraft*, Mitsubishi Aircraft News, available at http://www.mrj-japan.com/press_releases/news_110616.html (accessed on 12 March 2012).

Platzer, M.D. (2009) *U.S. Aerospace Manufacturing: Industry Overview and Prospects*, Congressional Research Service, available at http://www.fas.org/sgp/crs/misc/R40967.pdf (accessed on 11 May 2012).

Sukhoi (2010) *Sukhoi Superjet 100, Sukhoi Aircraft Profiles*, available at http://sukhoi.org/eng/planes/projects/ssj100/ (accessed on 8 February 2012).

Wong, D.K.Y., Pitfield, D.E. and Humphreys, I.M. (2005) 'The impact of regional jets on air service at selected US airports and markets', *Journal of Transport Geography*, Vol. 13, No. 2, pp.151–163.

Appendix

Table 4 Embraer RJ deliveries – list of countries

1	Argentina	25	Kazakhstan
2	Australia	26	Kenya
3	Austria	27	Libya
4	Bahrain	28	Luxembourg
5	Belgium	29	Mexico

Source: Official Airline Guide (2011)

Table 4   Embraer RJ deliveries – list of countries (continued)

6	Brazil	30	Moldova
7	British Virgin Islands	31	Montenegro
8	Canada	32	Mozambique
9	China	33	Netherlands
10	Colombia	34	Nigeria
11	Ecuador	35	Oman
12	Egypt, Arab Rep.	36	Panama
13	El Salvador	37	Poland
14	Finland	38	Portugal
15	France	39	South Africa
16	Germany	40	Saudi Arabia
17	Greece	41	Spain
18	Guadeloupe	42	Sweden
19	Hong Kong SAR, China	43	Switzerland
20	India	44	Taiwan
21	Ireland	45	Thailand
22	Italy	46	United Arab Emirates
23	Japan	47	UK
24	Jordan	48	USA

Source: Aviation Solutions Fleet Database (2011)

Table 5   Bombardier RJ deliveries – list of countries

1	Australia	20	Libya
2	Austria	21	Macedonia, FYR
3	Bermuda	22	Nigeria
4	British Virgin Islands	23	Philippines
5	Canada	24	South Africa
6	China	25	Russian Federation
7	Denmark	26	Slovenia
8	Estonia	27	Spain
9	France	28	Sweden
10	Germany	29	Switzerland
11	Greece	30	Tunisia
12	Hungary	31	Turkey
13	India	32	Ukraine
14	Iraq	33	United Arab Emirates
15	Ireland	34	UK
16	Isle of Man	35	USA
17	Italy	36	Uruguay
18	Japan	37	Yemen, Rep.
19	Kazakhstan		

Source: Aviation Solutions Fleet Database (2011)

Table 6 SPSS output

Coefficients[a]

Model		Unstandardised coefficients		Standardised coefficients	t	Sig.	Correlations			Collinearity statistics	
		B	Std. error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.645	.758		2.170	.031					
	GDP	2.302E-12	.000	.569	14.060	.000	.569	.569	.569	1.000	1.000
2	(Constant)	1.456	.733		1.987	.048					
	GDP	1.669E-12	.000	.413	8.574	.000	.569	.390	.335	.659	1.517
	Sum of deliveries two year lag	.264	.048	.268	5.559	.000	.509	.264	.217	.659	1.517
3	(Constant)	5.349	1.355		3.948	.000					
	GDP	1.724E-12	.000	.427	8.936	.000	.569	.404	.345	.654	1.528
	Sum of deliveries two year lag	.234	.048	.237	4.901	.000	.509	.235	.189	.636	1.572
	WTI crude oil	−.080	.023	−.134	−3.398	.001	−.188	−.166	−.131	.964	1.037
4	(Constant)	4.689	1.367		3.430	.001					
	GDP	1.428E-12	.000	.353	6.462	.000	.569	.304	.248	.491	2.035
	Sum of deliveries two year lag	.215	.048	.218	4.485	.000	.509	.217	.172	.622	1.607
	WTI crude oil	−.080	.023	−.134	−3.437	.001	−.188	−.168	−.132	.964	1.037
	Land area km^2	5.224E-7	.000	.134	2.687	.008	.463	.132	.103	.589	1.698

Notes: [a]Dependent variable: sum of deliveries